Vincent P. Gianella: Recollections of Geological Work in the West, the University of Nevada, and Following Western Trails

Interviewee: Vincent P. Gianella
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Description

Vincent P. Gianella was born at Marysville, California, on February 9, 1886 to parents of Italian and Irish descent, and he spent his boyhood on ranches in that vicinity. He obtained a Bachelor of Science degree at Oregon State College in 1910, a Master of Science degree at the University of Nevada in 1920, and a Doctor of Philosophy degree at Columbia University in 1937. Gianella served on the teaching faculty at the Mackay School of Mines at the University of Nevada from 1923 to 1952. A mark of the esteem in which his colleagues held him is the naming of a mineral in his honor; the mercury mineral Gianellaite was described and named in 1972.

Early in his professional career, Dr. Gianella worked in a number of mining camps in Treadwell, Alaska; Fairview and Tonopah, Nevada, and Jerome and Douglas, Arizona. He describes some of these places from the vantage point of a trained observer. Dr. Gianella first came to Nevada in 1912; his enthusiasm for Nevada and for Nevada geology is well known. He is a recognized authority on the Comstock Lode and was fortunate to have been able to examine most of the underground mines in the lode as well as the Sutro tunnel when these were still accessible in the 1920s and 1930s. Dr. Gianella's descriptions of the Comstock Lode and other mining districts in Nevada—Eureka, Copper Canyon, Pioche—will be of interest to persons concerned with both geology and Nevada history.

Dr. Gianella's other interests include beekeeping, earthquakes, the activities of former students, mineralogy, and western history. His research concerning John C. Fremont's travels through Nevada started about 1919. It reflects the meticulous approach of a person trained in the use of topographic maps and recognition of geologic features as described in old journals. It also reflects the extensive traveling he has done in search of Fremont's routes.

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An Oral History Conducted by Mary Ellen Glass

University of Nevada Oral History Program

Publication Staff:
Director: Mary Ellen Glass

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Preface to the Digital Edition

Established in 1964, the University of Nevada Oral History Program (UNOHP) explores the remembered past through rigorous oral history interviewing, creating a record for present and future researchers. The program's collection of primary source oral histories is an important body of information about significant events, people, places, and activities in twentieth and twenty-first century Nevada and the West.

The UNOHP wishes to make the information in its oral histories accessible to a broad range of patrons. To achieve this goal, its transcripts must speak with an intelligible voice. However, no type font contains symbols for physical gestures and vocal modulations which are integral parts of verbal communication. When human speech is represented in print, stripped of these signals, the result can be a morass of seemingly tangled syntax and incomplete sentences—totally verbatim transcripts sometimes verge on incoherence. Therefore, this transcript has been lightly edited.

While taking great pains not to alter meaning in any way, the editor may have removed false starts, redundancies, and the "uhs," "ahs," and other noises with which speech is often liberally sprinkled; compressed some passages which, in unaltered form, misrepresent the chronicler's meaning; and relocated some material to place information in its intended context. Laughter is represented with [laughter] at the end of a sentence in which it occurs, and ellipses are used to indicate that a statement has been interrupted or is incomplete…or that there is a pause for dramatic effect.

As with all of our oral histories, while we can vouch for the authenticity of the interviews in the UNOHP collection, we advise readers to keep in mind that these are remembered pasts, and we do not claim that the recollections are entirely free of error. We can state, however, that the transcripts accurately reflect the oral history recordings on which they were based. Accordingly, each transcript should be approached with the

same prudence that the intelligent reader exercises when consulting government records, newspaper accounts, diaries, and other sources of historical information. All statements made here constitute the remembrance or opinions of the individuals who were interviewed, and not the opinions of the UNOHP.

In order to standardize the design of all UNOHP transcripts for the online database, most have been reformatted, a process that was completed in 2012. This document may therefore differ in appearance and pagination from earlier printed versions. Rather than compile entirely new indexes for each volume, the UNOHP has made each transcript fully searchable electronically. If a previous version of this volume existed, its original index has been appended to this document for reference only. A link to the entire catalog can be found online at http://oralhistory.unr.edu/.

For more information on the UNOHP or any of its publications, please contact the University of Nevada Oral History Program at Mail Stop 0324, University of Nevada, Reno, NV, 89557-0324 or by calling 775/784-6932.

Alicia Barber
Director, UNOHP
July 2012

Introduction

Vincent P. Gianella is a native of Butte County, California, born in 1886. He received his early education in local schools, and then graduated from Oregon State University. His interests in geology led him to work in mining and later to advanced studies in geology at the University of Arizona, the University of Nevada, and Yale and Columbia universities. He became a faculty member at the University of Nevada in the early 1920's, and remained there until his retirement in 1952. A mark of the esteem in which his colleagues hold him is the naming of a mineral in his honor; the mercury mineral Gianellaite was described and named in 1972. Hobbies of exploring western trails and beekeeping added to Dr. Gianella's intellectual interests. Mr. Keith Papke' s introduction to this volume outlines and evaluates some of Professor Gianella's many accomplishments.

When invited to participate in the Oral History Project, Professor Gianella accepted readily. He was a cooperative, hospitable, and enthusiastic chronicler of his experiences and observations through nine taping sessions, all held at his home in Auburn, California between March and June, 1970. Professor Gianella's review of the transcript resulted in no significant changes or deletions, and only a few revisions of the text.

The Oral History Project of the University of Nevada, Reno, Library preserves the past and the present for future research by recording the recollections of persons who have been important to the development of Nevada and the West. Scripts resulting from the interviews are deposited in the Special Collections departments of the University Libraries at Reno and Las Vegas. Vincent Gianella has generously donated his literary rights in this oral history, with appropriate restriction, to the University of Nevada. He has requested that the volume be closed to research until five years after his death.

Mary Ellen Glass
University of Nevada, Reno
1973

Special Introduction

Professor Vincent Gianella, the subject of this oral history, needs no introduction to many people—his numerous students in geology and mineralogy during a thirty-year period at the University of Nevada, those persons interested in the geology of Nevada and the Comstock Lode, and the many citizens who came in contact with him during his long residency in this state.

Vincent P. Gianella was born at Marysville, California, on February 9, 1886 to parents of Italian and Irish descent, and spent his boyhood on ranches in that vicinity. He obtained a Bachelor of Science degree at Oregon State College in 1910, a Master of Science degree at the University of Nevada in 1920, and a Doctor of Philosophy degree at Columbia University in 1937. He served on the teaching faculty at the Mackay School of Mines, University of Nevada, from 1923 to 1952, and now is Emeritus Professor of Geology.

These bare facts hardly illuminate the life of such an active, interesting person. Early in his professional career, Dr. Gianella worked in a number of mining camps— Treadwell, Alaska; Fairview and Tonopah, Nevada; and Jerome and Douglas, Arizona—and he describes some of these places from the vantage point of a trained observer. He first came to Nevada in 1912; his enthusiasm for Nevada and for Nevada geology are well known. Dr. Gianella is a recognized authority on the Comstock Lode; he was fortunate to have been able to examine most of the underground mines in the Lode as well as the Sutro tunnel when these were still accessible in the 1920's and 1930's. His descriptions of the Comstock Lode and other mining districts in Nevada—Eureka, Copper Canyon, Delamar, Pioche—will be of interest to persons concerned with both geology and Nevada history.

Dr. Gianella's other interests are unusually varied and include beekeeping, earthquakes, activities of former students, mineralogy, and western history. His research concerning Fremont's travels through Nevada, starting about 1919, reflect the meticulous approach of a person trained in the use of topographic

maps and recognition of geologic features as described in old journals, but it also reflects the extensive traveling he has done in search of Fremont's routes.

This oral history covers a variety of subjects and experiences of a man with an unusual curiosity, a good memory, and a sense of humor.

Keith G. Papke
Associate Economic Geologist
Nevada Bureau of Mines
University of Nevada, Reno
1973

1

Family Background, Ranch Life

My Grandfather [Laurenzo] and Grandmother [Giaconda Galeppi] Gianella were natives of Canton Tacino, southern Switzerland, where the people speak Italian and are mostly of Italian descent, I presume, although my folks looked more Germanic—well, no more so than lots of other northern Italians. Grandfather was born in 1824. They migrated to France, where my grandfather was a glazier—you know, building—putting glass in doors and windows—and [an] interior decorator. He went to Paris sometime about 1851 or '2 (because my uncle [Agosto "Gus"] was born in Paris). Then about 1853 or '4, he came to America to mine gold. He landed in Philadelphia (I suppose he came over steerage on the boat, or probably worked his way over, because those folks were very poor in those days) and then came to California. Whether he went around the Horn or across the Isthmus, I do not know. He landed in San Francisco and then worked at placer mining for a few years up in the Mother Lode country of California—Georgetown and Monona Flat, near Iowa Hill and also at Sutter Creek—and I presume he was quite fortunate because he rented a ranch then. An old county history says that he made enough money in the placer mines to buy a dairy ranch which he operated for a good many years. While that statement may be true, it implies that he bought the ranch, but he didn't. He may have made enough money to buy several—I don't know. But that ranch was not bought 'til 1892 or '3. It was purchased by my father [Vincenzo Gianella] and my uncle. That was thirty years after Grandfather had the farm. And my father used to tell of delivering milk in Marysville when he was twelve years old.

My father came to this country in 1858 with his mother and brother, and they were brought to America by my granduncle [Guillermo] (William) Galeppi, who also did placer mining. He mined on the Yuba River at Swiss Bar a few miles above Marysville. Now, they came across the Isthmus on the railroad. (The railroad had been built then.) They took a riverboat from San Francisco and went up to Marysville. (Marysville at that time was the head of navigation on the Feather River

and was the supply point for the mines.) Then about, oh, in the middle '60's, I presume, Grandfather bought a ranch at Los Guilicos in Napa County, California. He farmed there for twenty or thirty years and then moved into Santa Rosa, where he died in 1892. I went to Santa Rosa with my father in 1891 or 1892 and remember sleeping on the second floor in a room facing upon the street. His old home was torn down when they built the freeway through Santa Rosa a few years ago.

Then Father and [my] uncle farmed the ranch near Marysville on the Feather River until the early '70's, when they moved up to the ranch on South Honcut Creek. These ranches were in Yuba County in the old Cordua grant. Cordua got a grant from the Mexican government in about 1839, and he owned all the way from the Yuba River on the south to the Honcut Creek on the north. [This was bounded by] the Feather River on the west (or Rio Plumas, as the Spanish called it) and on the east by the foothills of the Sierra Nevada, which is rather an indefinite boundary line. Of course, when the U. S. land surveys came through, they made a zigzag boundary on the east side to include this 40,000 acres or so that Cordua owned. They left the north-west-south boundaries as stated.

And by the way, this creek, the Honcut Creek—or Arroyo Honcut, as they called it—was named from the Honcut tribe of Indians that had a rancheria down where this creek joins the Feather River, about six miles west of our home ranch. Cordua liked these Indians and named his land grant after their tribal name. The Arroyo Honcut (the North Honcut Creek) was originally called, by Jedediah Smith, the "Red Bank Creek," in 1828 while he was on his way north to the Columbia River. So he crossed over our ranch, we now know, because the creek has a red bank on the northwest side for only about a half mile, so we know he crossed somewhere within that half mile. Also, he said he camped about four miles from Feather River while he was beaver trapping there, and that would also put him about where the little town of Honcut now is (or village of Honcut). That's where we used to get our mail.

Then Father bought this ranch from a man by the name of Walker, the Honcut ranch; it was on the south bank of the South Honcut Creek. And in the 1890's, he also bought the ranch that they still farmed down near Marysville, three miles from Marysville. They bought the Honcut ranch, about 1,400 acres, on credit and paid their debt within four years by cutting wild hay and selling it to the miners. They sold that ranch sometime in the early 1900's; that is, the ranch at Feather River. And he also ranched on a ranch now known as Pacific Ranch, on Feather River, at the junction of the Honcut Creek. At that time it was known as the Nelson ranch. (I remember that well; we used to go down there catfishing on Sundays and "borrow" grapes from the man named Gatchgens, who lived along the road [and who] had some fine grapes [laughing].)

When Father moved out to the Honcut ranch, there was an oak tree in the corner of the yard. That was in the early 1870's—probably '72, '3, '4, somewhere in there. My mother said that oak tree was then eight inches in diameter. And I remember it when it was about two feet in diameter and under forty feet high in the 1890's (because I could look over it from the windmill, which was up forty feet) and now, it's up about, oh, sixty or seventy feet high, and it's fully six feet in diameter—a huge oak tree.

I guess I'll tell about my other grandparents. Grandfather Hagan—Henry Hagan—was born in 1813, in Armagh, Ulster, North Ireland. He studied the carpenter trade, and he immigrated

to America in the early 1850's, probably due to the famine in Ireland. (You know, they had a tremendous famine when the potatoes were killed by some sort of a blight, and a great many thousands starved to death.) He landed in Montreal, I presume, again from a freighter, possibly, and probably worked his way over. (I never heard. I wish now I had found out.) He went from there to St. Louis, where he stayed for a period of time, and there he married my grandmother, who was a native of St. Louis, Missouri. She was born in 1824. Her maiden name was [Mary] McClosky, and her parents came from Virginia.

They crossed the Isthmus before the railroad was built, so it must've been 1852 or '3. Because Grandfather walked across with one of the children, and Grandmother rode a mule across [laughing]—carried the youngest one, which was not a pleasant journey as the trail was extremely rough and muddy, and there were heavy tropical rains. I know that two [of the children] were older than Mother [Mary Hagan Gianella]. (She had, I think, four sisters, one of whom married a captain [William Trainor] who sailed all over the world, mostly in the Pacific Ocean. I remember her getting letters from her sister from Yokohama, and what's the name of that town 'way up north, the northern island of Japan, where the Ainus live? Oh, yes, from Hakodate, Hokkaido Island. I remember seeing mail coming from there, Nagasaki, and several other Asiatic ports. He hauled a great deal of lumber. He used to get lumber up at Port Townsend on Puget Sound, which is not much of a port nowadays, but it was a great port in those days. [Trainor] was one of the last operators of the large sailing ships carrying freight on the Pacific.)

So they crossed the Isthmus and came to San Francisco, where Grandfather did carpenter work. He helped build the old St. Mary's cathedral, which is now down in Chinatown. It burned in 1906 during the big earthquake and fire [and was] rebuilt. Then he bought a prefabricated house, which was made in France and shipped around Cape Horn, and he hauled it up to Sonoma County and erected it in Bennett Valley, on Matanzas Creek in 1856. Mother was born there in 1858. (You know, "Matanzas" was the Spanish word for "slaughter." That's where they slaughtered their cattle. That's where Matanzas Creek got its name; you see the name used quite frequently by Spanish-Americans.)

Now, that was about three miles out of Santa Rosa, southeast of Santa Rosa. It's now within the town. And the old house is still standing. I helped repair it back in— well, I think it was 1903 or '4, and saw all these numbers on the boards. It was all numbered and blueprints came with it so it would show you how to erect it, sort of a do-it-yourself proposition. (Some people think that the prefabricated houses are something new. Do you know they even shipped granite, hewn, ready to erect, from China to San Francisco? Some of the old buildings are made from granite quarried in China, and dressed in China. They also shipped some of the laundry from San Francisco to the Hawaiian Islands in the early days.)

In back of that house is an elderberry tree, three and a half or four feet in diameter and about twenty feet high. Now, that was planted by my mother in 1866 or '67 from a switch that she broke off of an elderberry bush up in the hills near the spring when she was driving the cow in to be milked. That's probably the biggest elderberry tree in the state of California, if not in the world, and it's hollow inside. People think it's dying because it's hollow. Elderberries are all hollow. They have a pith inside; the core is hard wood.

Father was brought over here from Europe when he was a youngster eight years old.

And Father was a man of about five feet ten, weighed about two hundred and twenty-five pounds, was very active, rather a serious man, but full of humor, [a] great storyteller, had dark brown, wavy hair and a reddish beard, florid complexion, light brown eyes. He looked more like Irish or German than what we commonly think of as Italian.

And my Uncle Gus was very blond and light blue eyes. By the way, I had an older sister that looked very much like him, and a cousin that lives up at Constantia, one of the Galeppi boys, Fred Galeppi, who's almost an image of Uncle Gus—blue eyes, blond hair, and so forth.

Now, let's see. Oh, yes, Father spoke his native language, of course, Italian, as well as French, English, and Spanish, very fluently. He died in 1916 in his 60's. That'd make him—let's see—sixty-six, I think. He died comparatively young of liver trouble.

Now, my mother's maiden name was Mary Hagan. She was born on the old ranch at Santa Rosa, and planted that elderberry I told you about. She sold the ranch about 1920, or possibly a little earlier. It's now all built up of houses, or mostly so. Oh, yes—I used to wonder about Mother being such an ardent southerner. I know now [laughing] because I learned something of her background, with her mother having been born in St. Louis, Missouri, of parents from Virginia. I never understood that before.

Mother was quite a, what is nowadays called "first aid." In those days, we said she was the local doctor [laughing]. She sewed up and patched up more people! One man, who had got into a fight in a saloon about half a mile up the road and had his head carved up with a broken beer mug, bled like a stuck hog. You know how people do bleed from scalp wounds. She fixed him up and sewed his scalp together—no anesthetic. I guess they poured vinegar on the wound or something; we had no antiseptics. Turpentine was a favorite. She also sewed up a man [by the] name of Tom Wilson. Somebody split his scalp for about five, six inches with a knife. She sewed that up the same way. They didn't go to the hospital. They never went to a doctor after that, and none of them died. They all recovered. I guess we were [laughing] tough in those days. I remember all these things from the time I was quite young, early teens or before. I know she also used arnica and iodine and—not many other [remedies]. We didn't have much in the way of medicine. No drugs at all. Plenty of hot water and soap. And, of course, our water wasn't all contaminated in those days, and the air wasn't full of germs as it is now.

Well, let's see, something about the ranch life: There were six boys and three girls in the family, and of these three men are still living. I was born February 9, 1886. Oh, yes, we did our own blacksmithing—some of it. Father blacksmithed; my older brother Thomas blacksmithed. My brother younger than me, Henry, was quite a good blacksmith, rough and ready blacksmith. I did a little pounding on cold iron. I used to help the blacksmith, Jim Keith, and others, swinging the eight-pound sledge for the heavy work in the wintertime—oh, sometimes in the summertime, too. The old anvil we used to use is still on a local ranch.

And, let's see, we rode after the horses and cattle and sheep, and it was our duty to supply the sheepherders with supplies. The pasture lands where they wintered were up in the foothills. Father had several thousand acres of land up in that neighborhood, and rented a lot more. At one time, he had about ten or twelve thousand head of sheep, and I think a hundred and fifty to two hundred head of

horses and mules that we used working on the ranch. And we sold some mules; we shipped some to the Hawaiian Islands, I know for the sugar plantations over there, to Hilo, I believe. That was in the 1890's.

A great event was going up to the mountains in the early summer with the mules and horses, [to] take them up to the Big Meadows, which is now Lake Almanor—covered by Lake Almanor now. We had a ranch up there, a small ranch (160 acres), and we rented the Gould ranch. (The Goulds were neighbors who lived just south of us about a mile.)

We ran our sheep up in Plumas County for summer pasture between Quincy and Greenville. I remember that because I went up there with my father in 1896 or '97. We drove up by way of Wyandotte and Bidwell's Bar and Letterbox, and down past Buck's ranch, where Buck's Lake now is, and through Spanish Ranch (where I caught my first trout), and from then on into Quincy. And the reason we went up was because he had a citation for pasturing of sheep in Plumas County and not paying five cents a head tax. The county put on a tax in those days, and shortly after that, it was made a national forest, and so the county couldn't tax. And one of our neighbors, Steve Gardella (Steve ran sheep, and he also spoke four or five different languages, quite a well educated man) had a little ranch two or three miles from us up on the South Honcut Creek. And he was in the jail up there; he wouldn't pay the tax, and they put him in jail. Oh, yes, another neighbor of ours was in the jail, too. Vien, he was a Frenchman who had a small ranch a few miles up in the foothills, and he said [as] long as he got good board and lodging, he'd just [as] soon stay in the jail as to pay his fine. They didn't keep him in jail, though; he just slept there and then walked around the town. They knew he wouldn't go any place, couldn't afford to, so he didn't escape. Anyway, Dad paid his fine, rather than to stand trial.

And the next time I went to Quincy, I rode in on a mule in 1907. I rode a mule from the ranch up to Quincy, about eighty miles. That time, I went up to bring the sheep down. And although my older brother Thomas is three inches, at least, taller than I am, and weighed about two hundred and thirty or forty, evidently there was a strong family resemblance, because when I was sitting down in the hotel to eat supper, the man across the table said, "You came up to bring the sheep down, did you?"

And I said, "Oh, yes." That was in the old Plumas House, which since burned down, and they built the Quincy Hotel, and that burned, here not long ago.

Of course, that was a big event, when we were going to the mountains. I remember driving, with others, the mules up one June, about 1902 or '3, and it started snowing about noon when we got to about Inskip. (Snow was a novelty. We seldom had it at the ranch.) Inskip is on the road above Magalia, which we called *Dogtown*. (That was its name, and we always called it Dogtown. We thought Magalia was sort of a fancy name and really wasn't official. It was, but we didn't know it and we always knew it as Dogtown.) Above that was Inskip, and we tried to get a corral there, and we couldn't. We went to the next ranch and couldn't get a corral there for the mules, either, so we went to Butte Creek House, which is on the upper end of Butte Creek, which flows into the Sacramento River near Sutter Buttes, and nobody [was] there. Of course, they hadn't opened yet in the spring—still snowing. We got in about midnight. Potatoes were frozen [so] the cook couldn't cook them. We got a

rather poor supper, and breakfast also. The cook was a Frenchman that had never—I don't think he ever drove a team of horses in his life. He was driving our chuckwagon and served as cook. And we were sopping wet; finally got dried out and got a little sleep.

During the night, we stood guard over the mules because they were so hungry they would eat the old logs that the corral was made of. They'd gnaw on those, and finally the log broke and they jumped over. As they'd been over the road before, they headed for where the food was, up over the mountain. And my brother was standing guard, and he pounded on the side of the house with his quirt and woke us all up and told us that he was going to follow the mules. They were already on their way over the mountain.

So we followed him—saddled up and followed him—and got over to Little Bear Valley, I think they called it, just over the summit five or six miles. There was about five feet of snow on the summit. In some places, the horses would break through up to their bellies in the soft snow. We waited. We built a big bonfire to get thawed out over in Bear Valley and waited for the Frenchman to show up with the trap wagon. We'd gone about eight, ten miles. And lo and behold, here he came, finally. How he got over, I don't know. He made it. The way he explained it to us, he says, "Horses go, wagon come." That's all there was to it.

When we came back several days later, the snow had melted off pretty well so we could follow the road over the summit, from the wagon tracks, up hill and down dale. How he ever made it, I don't know. We could see his wagon tracks [laughing]. But, I guess, not knowing any different, he had no trouble whatsoever.

My earliest memories—I remember old gold miners who used to mine down on the creek right near the schoolhouse. remember a teacher, Miss Jennie Mullaley, whose folks lived up in the mountains on a little ranch. Another teacher was one who first encouraged me to go on with my schooling. She was probably responsible for a most important turning point in my life. I feel very thankful toward her, though I cannot recall her name. So I took an extra year from this ninth grade school and got about the equivalent of second year of high school—equivalent in those days, not now. How I ever got into college, Lord only knows. Passed an examination, I guess. Then I remember also an old Greek miner by the name of Skip Alexander that mined on our ranch up in the hills about two, three miles from home. He was mining on some old gravel, with a little, low tunnel, and we used to visit him, and we'd have to stoop over to go in this little old tunnel. And when he mined it out, and he put up a rock or short post to hold the roof from falling down. It's all caved in now. I saw the same country about two weeks ago (1970). It's all been mined by dragline dredges now.

Also, I remember farming on the Nelson ranch. They rented the Nelson ranch down at the mouth of the Honcut Creek where it joins the Feather River. And they drove about 150 - 200 turkeys from there up to our ranch. When I heard about those turkeys coming up, I was all ears and eyes to see those turkeys. And it took them two or three days to drive them up there—oh, probably six or seven miles—and, of course, that was a long time for me (as a small lad) to wait for the turkeys to show up. I'll never forget the turkeys because I'd never seen any turkeys before, and along in the evening, they would walk around looking up in the trees for a place to roost. They're different than chickens because turkeys always want to roost high, and I remember that.

Also, that year, Father had bought a Holt combine harvester that took twenty-six head of horses to run it. A Mexican that we all called "Compadre"—we had no other name for him—was the teamster. It was a big, red harvester, and it made a great impression on me—much more so, I think, than these new jets make on the youngsters nowadays. They see so many things that nothing appeals to them, I don't think. That's as early as I remember, in 1889 or '90, which meant I was three or four years old.

Another thing—I remember going to Santa Rosa with my father in 1891 or '2, when I was five or six years old. I remember that quite well. And a trip my mother made to Santa Rosa when I was about that age, also. And I remember the big flood in 1892 because our ranch was flooded, and one of the men drove my mother to Marysville to take the train to Oakland. My brother Thomas was going to college there, and he had pneumonia. They had to drive to Marysville because the track was flooded between Marysville and the Honcut railway station. And the man who drove down had to spend the night in Marysville before he could get home because of the road flooding in the meantime. So to get home, he had to drive up the Yuba River along the Brown's Valley grade and come back home by a back road. I believe that's 1892 or '93. And that was one of the biggest floods they had had for some time. Of course, I used to hear my mother and father talk of the flood of 1861 and '2, when the whole Sacramento Valley was under water. We've never had such a flood as that since. If we'd get one now, practically all these valley towns would be flooded. And the levees—the levees amount to nothing; it'd just go over those levees. You couldn't levee it. The bypasses wouldn't hold it. Nothing. Of course, they ran steamboats out almost to the Sutter Buttes to pick up stranded people and cattle. Some of those steamboats got stalled out there, three miles from the Sacramento River, and they had to drag them back into the river later.

I remember when, along [the] early 1900's, it must have been, I went down to the "tule land," as we called it in Sutter County, to bring the flock of sheep home. They were five or six miles west of Nicolas. It had been pasturing down there during the summer, and this was along in September or October. There'd been some very heavy rain, so we expected the place would flood. (It is now in the Sutter Basin, what's now known as the Sutter Basin, what's called the Sutter bypass, to carry flood water from the Sacramento River near Colusa across that country and dump it into the Feather River, above its junction with the Sacramento. They've got a big canal in there now. That's the Sutter bypass. But in those days, they didn't have the thing, but they did have a weir further down the river from Colusa, known as Tisdale weir. When the river got high, it'd overflow that weir.) And about sundown, I looked off to the west and could see reflections from water about two miles from camp. That country there is quite flat.

So I said to the herder, we ought to start out with the sheep. (Of course, I was a kid in my early teens, and he wouldn't pay any attention.) I remember we had two tents, and I slept in one tent on the bales of hay, and early in the morning, before daylight, I heard an odd noise, sounded very peculiar. I wondered what it was, and I stepped out of bed to see what it was, and I stepped in water about six inches deep. So we were almost surrounded by water. If you know sheep, they won't cross water two or three inches deep, even. They just balk. Fortunately, we had a higher dry place up onto the levee about half a mile away. We were able to drive the sheep

up on the levee and get out of there before the water got too deep. Then we came back and gathered up the camp equipment and threw it into the spring wagon, and I drove that out. But if I hadn't noticed it for a couple of hours, we'd've lost all those sheep, fifteen hundred or two thousand head of sheep. They're probably about the dumbest creatures that people have on ranches.

Then up at Hamilton—I mean near Hamilton City, on the Sacramento River in Butte County, ten miles northwest of Chico, we had a ranch there of 4,200 acres—mostly farming land. A great deal was overgrown with timber: oak, sycamore, and willows. We cleared out hundreds of acres of it, and then put men to grubbing out the roots and pulling up the stumps (we had what we called a *stump puller*. Now they would be shoved out with a bulldozer.) And then we fenced about a hundred goats in there, and they would eat up all the sprouts, eat everything clean. That kept the trees from growing again. And after a few years, you could plow it and put it into cultivation. It's all in orchards nowadays. And last winter, it flooded because of the Shasta Dam being opened at the wrong time.

One day our herder, with a band of about a thousand sheep, sent his dog after them to hurry them through brush. They stampeded across a steep-sided gulch. Some fell, others tumbled on top, and before those on top could be removed, about a hundred sheep smothered. Don't be hasty; *mirabile dictu*.

Our biggest floods up there always came when the gates on the Shasta reservoir opened when the Sacramento River was at full flood. So whenever you have a dam that's supposed to make power, irrigation, flood control, recreation, et cetera, flood control comes in at the tail end. You know, they brought the Trinity River over now, to make power, and dumped it into the Sacramento, and that runs day and night, flood or no flood. They can't afford to lose all that power. So you have the Trinity water added to the Sacramento whether it's up or down.

I believe it was in 1898 when they had a very severe drought in the lower San Joaquin Valley, and also in the mountains down there, so they didn't have summer pasturage for the sheep. So there was tens of thousands of head of sheep driven up four or five hundred miles to the pasture in Plumas County and Butte County in the mountains. And during May and June, there was flock after flock moved past our ranch, and almost unceasing for days and days on end. A lot of those sheep starved on the way, and they were selling them for fifty cents or a dollar a head. I never heard of such a drought since that time, although there were droughts—early droughts in California, you know, along in the '60's. About 1863 or '4, I believe, they had a drought where there was no rain for fifteen or twenty months.

When I was a youngster, I didn't plan to be a rancher. That didn't appeal to me—up at five o'clock in the morning, and to bed about eight at night, and very little recreation. Well, it just didn't appeal to me. It's very beautiful country, and, of course, I didn't realize that at the time, either.

When I got along in years, a great many people would tell me that they thought I should go away to the university and get further education. I thought at one time of taking up medicine or law, and I knew that was a rough line unless you had some support. My father could have got me into a law office, or a medical office, if I had had the training, but I knew he wouldn't do it because he wanted me to stay on the ranch. I know the man I helped (in 1903) survey the Nord ranch up on the Sacramento River; his name was McMurtry. McMurtry got the contract for surveying the Hoopa Valley Indian reservation on Trinity

River, and I knew he wanted me to go up there because, although he hadn't said anything to me about it, my father came home from Marysville one evening and asked me if I had promised McMurtry that I'd go up and help survey the Hoopa Valley Indian reservation. That's the first I had heard of it. So evidently he had inquired if Father would let me go, which the answer, of course, was No. So I never got to see the Hoopa Valley Indian reservation up on Trinity River, which I would like very much to have done.

You know, in those days, we used to drink out of any creek, spring—anywhere. Perfectly safe. Nowadays, you can't do it. We obtained our drinking water from the creek about three hundred feet from the schoolhouse. And it was the job for the bigger boys to carry the water, get a bucket of fresh water every so often. And we all drank out of the same dipper and out of the same bucket, and we all survived. Very simple, no?

The last two or three years I was in grammar school, they decided that the creek water may not be so good. Well, of course, the creeks would go dry and then we had to haul water from the neighbor's, about a quarter of a mile away, the Civils ranch (that's no longer in existence, either). So they put down a well at the corner of the schoolhouse yard because that's where you should have a well, right in front of the school—a little off to one side, a handy place, although the rock was hard greenstone, a metamorphosed lava rock, and as dense as dense rock can be. And they sank it down to a depth of about thirty-five feet. One of the contractors was Jim Keith, our blacksmith, a jack of all trades and quite good at almost everything. The rock breaking was done by hand-drilling and the blasting with dynamite ("Giant powder"). The water, it did for the school all right, so far as quantity was concerned, but the quality lacked considerable. In other words, it had a strong taste of dynamite and tar from the fuse that was used in blasting. I can still taste that water yet [laughing]. It never did get over that taste all the time I drank out of it, for at least two or three years. I suppose afterward, it got all right. Now, of course, it's filled up, and the schoolhouse is torn down. They're going to run the road up through where the schoolhouse used to be, to take out a lot of kinks in the road.

Oh, by the way, in the late 1890's, when I was quite young, a runaway team one Sunday came down past the house and turned out into our field. They had a wagon attached to them, and went into the field through an open gate, circled around, came back out through the gate again, started back up the road, and we ran them down and caught them. And then we went up to see what the trouble was, and we got up about to the schoolhouse, and one of the neighbors and a friend of his (both of them pie-eyed) had this man in a cart, taking him over to the doctor. Good Samaritans. His head was resting on the tire of a wheel, and by the time he got to the doctor, he had a hole worn through his skull. So if he wasn't dead when he got thrown out of his wagon with that runaway, he certainly was before they got him there. That was our ambulance service.

[Laughing] Another thing I remember was the people that lived on the Jim Bryden ranch, which was about a mile to the east of us (they were of f the Honcut grant. They lived on the government land), and they had a man working for them. His name was Springer, George Springer. (I saw George later, in 1903, when I was down in Oakland going to school. He was a policeman in Oakland.) At this particular time, about 1900, he was sharpening mowing machine sickles. You know, they get dull, these sickle bars, and they vibrate to and fro and cut the

hay. And it was along in May, of course, and he was sharpening up the sickles, and a big lout—I don't need to mention his name—he was none too intelligent (as a great many of the farmhands were not noted for their mental development) —he came along to grind a sickle on the opposite side. Now, this grindstone is power-driven, and you always sharpened your sickles with the stone running away from you. The one on the other side of the stone, the stone revolving toward him, to sharpen the sickle, naturally, it caught on the stone, and it flipped over and hit the man on the other side (Springer), cut off the tip of his nose, about an eighth of an inch of it, and struck down into his chest just above the heart.

They went over to Honcut on horseback to get the doctor, a Dr. Horton who also ran a drugstore. That was about four miles, mind you. They sent another man on horseback to Marysville for a doctor, which was thirteen miles away. The old doctor at Honcut, Dr. Horton, ran his horse over there (he drove a horse and buggy). He ran his horse all the way over, and the horse died from his exertion.

He never got paid for his bill, either. He got ahold of the artery that was severed and held it with—let's see, I think he had to hold it together with a clamp and his fingers 'til the doctor arrived from Marysville [laughing] a couple of hours later. Of course, see, it took this man a couple of hours to get to Marysville, two hours at least, thirteen miles. And it took the doctor another couple of hours to get out there, so it must've been four hours before the other doctor arrived. This man Springer grew up very healthy. He was sort of a frail man before that, but he took on weight and was a very healthy man. Probably the bleeding did him some good, so the old doctor's [laughing] theory of bleeding probably [laughing] wasn't so bad after all.Well, that's enough of those gruesome things.

Another thing I remember of my own childhood—we went through the blacksmith shop, and there was a little trail that led up onto the bridge over the South Honcut Creek through a little gap in the fence. And the bridge had rock abutments on each side to keep the creek from washing away the banks. And there alongside the trail was a little stake there about two inches square and a few inches tall. I was on the outside, and my sister was ahold of my hand, so I imagine I must've been quite a young tot, and we went up there to see the children coming home from school, the older children. And I would step on that peg. She told me not to do it, and I stepped on it, and it broke, and I fell down over the rock wall, and that's where I got this scar here on my face. I got this one [over the right eyebrow] from running in to dinner and falling and hitting my head on a plank of wood. I was older, should've known better at that time.

And that bridge across the South Honcut Creek, we used to ride our horses under it. It was high enough to ride through on horseback. And the horses used to go from the corral up through there, and we'd open the gate onto the pasture and back and forth.

Then, we diverted that stream. On the Bryden ranch, about a half mile east of our house, we diverted it, made a right angle bend there, and it was only about three-eighths of a mile down to the Prairie Creek, which came close to the other there. Then we plowed out between them, and when the floods come to wash that plowed ground out, and finally the stream all was diverted into the Prairie Creek, and we dammed up the South Honcut. (This is an editorial "we;" I was probably about nine or ten then.) So a great many people now think

that the Prairie Creek is the South Honcut Creek. In fact, it is so called on all official maps. The real South Honcut is all sanded up. So where the bridge was, now they have, I think it's a four-foot pipe, and they don't need that but for rarely. We had a swimming hold up there, too. Now it's all a mass of sand and about bank full.

Even the government surveyors have made errors in making maps and putting the county line down through Prairie Creek. Because now all the water goes down there, they just naturally think that's the original South Honcut Creek, and a lot of people call it the South Honcut Creek. What *was* the South Honcut Creek, they don't call it anything; it's just a sandy depression. I saw a map just the other day that shows the county line between Butte and Yuba counties going down Prairie Creek. Actually, it goes down the old (original) South Honcut.

I had some people, when I was a young boy in my early teens, come up and asked me about some ranch. And I said, "Oh, it's up in Butte County." And I motion up—up off to the north.

And he said, "Well, we're now in Butte County."

And I said, "Oh, no. You're in Yuba County."

"Well," he said, "the county line's down there at the South Honcut Creek, isn't it?"

And I said, "No, the county line is about two hundred feet up the road from you, where the South Honcut Creek actually is. That sandy wash through there *is* the South Honcut Creek." He thought I was mistaken, naturally.

Now, let me see. Oh, yes, the big floods at Hamilton. That's about all I remember about the Hamilton City ranch. We had a lot of farming there and plowed many, many acres and put in most of it to barley. Then when I was going to college, beginning in the fall of 1906, I used to come home in summer during vacation and run the combined harvester. We had about thirty-four head of horses on the combined harvester. And the header tender and the sack sewer and the driver each took care of a third of them. If there was more than—if it didn't divide up into thirds, the teamster took the odd ones, any leftovers, on his team. So he may have fourteen horses, where the other fellows only had ten horses, which is quite a few to harness up at four or five o'clock in the morning. And then we'd start out about six or six-thirty a.m., and go out to the combined harvester and wait 'til the grain was dry enough to thresh. You couldn't thresh it 'til about ten, because it had to dry from the dew which fell at night, but we had the teams all harnessed up and out there, just the same, rain or shine. We commonly had heavy dews near the river, while a few miles away on the uplands, we would hear the machines start up about sunrise.

I remember the last year I ran the combined harvester. I guess it was the summer of 1908 or 1909, and we threshed something like 16,000 sacks of barley, which was quite a crop. We used to cut hay off of that same land in alternate years, and I remember hauling hay to the stack earlier than that, in June, 1904 or '5, when the temperature was 119° for two days. Talk about hot! It was humid down there also.

I remember once my brother and I went down on the Sacramento River. Mother was visiting us up there then. She used to—most of the family usually lived down at Honcut, and just a few of we boys lived up at the ranch near Chico. We went down in the field to repair this fence, and it was in a grove of willows and cottonwoods, no air stirring at all, and, oh, it was very hot, probably 104° or '5°, something like that. And I know we worked

down there for several hours; I forget how long. And we drank up, I think it was, three or four gallons of water between us. It would just run out of you as fast as you would drink it. And so we came back to the ranch, and we were sopping wet. [Laughing] And Mother was all excited, thought we'd fallen into the river. We didn't have to go to the river to get *that* wet! We were just dripping wet! I've never seen people so wet from perspiration as we were then. I should say sweating. It was more than perspiration.

We didn't have the excitement up there of the people carving each other up. That seemed to take place around the foothills. The wilder people are around the foothills, and they still are, sort of hillbilly type. We didn't figure we were hillbillies because that name hadn't been invented yet. But anyway, we lived down on the flatlands. Felt we were superior to those up in the hills.

Also, I remember when they put the road across from Chico to Orland, which went right across the river on our ranch. They put in a steel bridge with a drawbridge—a rotating drawbridge—so the steamboats could go through. And the steamboats used to come up there, [and] we loaded some grain on the steamers. A great many of the men of the crew were largely Hawaiian, and we called them "Kanakas." I think they called themselves "Kanakas," didn't they? And they could swim like fish. I never saw such swimmers as the Kanakas. They'd swim ashore and bring the cable in to tie up the boat. And they were happy-go-lucky people, always joking and laughing and singing and carefree, and doing hard work, taking this grain down and loading it on the steamboats. It was very hard work. Those steamers used to run all the way to Red Bluff in those days. They don't any more; that drawbridge is never opened. They used to have a bridge tender there, that opened and closed the bridges. And they strung a big power cable across. The engineer that surveyed the bridge's name is Soule, from an old, early-day San Francisco family. One of the Soules wrote a history of San Francisco, and they were quite prominent in the 1850's and '60's—probably still are; I don't know. That sort of transportation cannot compete with modern trucks and paved highways.

I was on the ranch near Hamilton City, and I told you about some of the things we did there. During the big floods, there'd be just hundreds and hundreds of cottontail come up to the ranch, and quail by the—oh, I don't know, a thousand or more quail. We'd go out and feed them because the poor things starved to death otherwise. And rattlesnakes galore—they'd come up, too, around the ranch. Of course, a lot of the rattlesnakes drowned, but some would float in on driftwood and come around the place. We made short shrift of those. The cottontail, we'd kill a few, of course; they were good eating. But the quail we fed and let them go.

We had some Indian mounds on the ranch, Indian burial grounds. And we had one where we dug up some Indian skulls. I was always interested in that, and I sent some to the University of California, but never heard from them. They were found about 1904 or '5, and I took one up to college with me, one of the skulls. The skull was thick, very thick; one of them was about three-eighths of an inch or so thick. And the teeth were ground down; they're flat, practically to the jawbone. (I think most Indians' teeth were, because they had so much grit in their food.) They were buried in a sitting-up position, with their knees drawn up to their breasts and their arms folded and with their hands over toward their shoulders across the chest. A little papoose we dug up had a necklace of abalone shells, pointed—sort of long, slender triangles with

holes through—and they were all fanned out as though they were probably on a buckskin thong around his neck. He or she faced to the west. And over the heads, there was about three inches of ashes.So evidently, when they buried these people, they covered them up with about four or five inches of soil over their heads, and then they built fires over that [for] week after week, or years after years, and finally ashes built up a depth of three or four inches. And then there was about a foot and a half of soil over that that came in from the river flooding. Therefore, those graves were probably quite old, many thousands of years.

Then we had another one we called the "Indian camp," which was about a mile down on the ranch, a mile and a half, on the Sharkey ranch, which was part of our ranch. That was on the edge of a slough, and they had a deep pit there where they had a sweat house, or as the Spanish called it, "terriescal." (Sweat houses seem to be common all over the world, especially in Asia, but they were [also] in Mexico and California. Lewis and Clark mentioned some, you know, up on their trip into Oregon. One of the men became quite ill on the return trip, was carried on a stretcher. He finally decided to take the sweat cure. Jumping hot from the sweat house into cold water, he got well, too. And, of course, they have sweat houses in Asia, and the Finns are strong for hot baths, and so are the Japanese.)

There was a man came down from Oregon and worked on our ranch. [The] name is [Robert] McKinnon. He served as our ranch foreman. And McKinnon played football at Oregon State. He told me that I should go away to college, and he encouraged me to go up to Oregon State. So I packed up and went. I wrote for the catalog and went up and took the examination and was admitted. Here is another to whom I owe much for changing my way of life. I hope I have also helped others.

2

College, My Early Career, Marriage

College Days

I had a terrible struggle getting through [Oregon State] because I didn't have nearly the background and preparation that most of the students had. So I had to do about four and a half, five years of work in four. But I made it. I first took electrical engineering, and when I got through with my junior year, I saw I wasn't going to care too much for electrical engineering, I really was not qualified along that line, but I got very much interested in mining from some of the other students there. They had a mining school at that time, the Oregon School of Mines, which has since been discontinued.

So I took enough chemistry, and surveying, and some other courses, in addition to the subjects in electrical engineering, so that the next year I'd be able to take, I think it was, forty-four units to graduate in mining engineering, which was just a romp after all the math and physics, et cetera, that I had in electrical engineering. So, during my mining [studies], I had to take more chemistry, but that was easy for me because it appealed to me greatly—mineralogy and assaying and all those things. So I graduated that year in the upper tenth of my class.

And then when I finished college, I went over and asked the professor in chemistry, [laughing] old Johnny Fulton, not the inventor of the steamboat, but probably just as tough a character—. Fulton had graduated from the school of mines some years before—no, he hadn't quite graduated. He got in a row with his professor, so he quit school; he was a dropout. He went up to Portland, Oregon, and got a—what would you call it? It wasn't a position, surely. He signed as a common sailor before the mast on a sailing ship and spent two or three years sailing around the world. And I remember his telling us that he stopped at Santander, Spain, that's up on the Bay of Biscay, and I guess that's where Viscano came from, the great explorer. (They tell me no, that he came from central Spain, but he had the name "Viscano," which means he was from the Biscay province. I guess his parents were, or his relatives.) Anyway, he (Fulton) landed

there at Santander, Spain, and he said he walked miles and miles inland to a zinc mine because they had crystals of white sphalerite (zinc sulphide). And I've never heard of white sphalerite crystals from that day to this—they are usually brown or black. Well, after about three years before the mast, he decided he'd had enough (like Dana did, after two years) and he came back to school and finished his course and became professor of chemistry.

He was a very good professor, too. Oh, but he was hard, though. He was a tough one. Every once in a while, if we didn't get our lessons properly prepared, he'd say, "I'll keel haul the whole bunch of you," which meant he would throw us overboard tied to a rope and drag us under the keel and up the other side, which was pretty rough treatment. I suppose we deserved it, too, although he didn't do it. Probably would, too, if he had us at sea. But I remember him as one of my outstanding teachers. He and Mrs. Callahan, who taught English, were the two teachers that I remember best from Oregon State.

By the way, when I was at Oregon State, my side partner, who became quite a noted man afterward (we were juniors together), he played end on the football team and was afterward a state farm advisor in agriculture. His name was Leroy Breithaupt, so naturally, we called him "Hoppy." Well, Breithaupt and I had a bright idea—I don't know whose it was, probably his, because I never had many bright ideas. We decided to take the old souvenir Civil War muzzle-loader cannon out and fire them off—you know, make a big noise. So we wheeled them from the armory down onto the campus, way out about the middle. They had a big, long campus out in front of the main building. We wheeled them out there, and we loaded them up with powder and a fuse. See, each cannon had been spiked because we weren't the first students who had fired those cannons. They used to take them over and fire mud at the girls' dormitory about midnight. But we didn't do anything like that. We went down there and fired them off, and we had such heavy charge in them, they'd set back on the tailpiece, and the wheels'd actually come up of f the ground three or four inches, and they'd just rattle. You could hear the rattle for—I imagine you could hear it for blocks away.

And the old commandant came rushing down there. He didn't even take time to put on his leggings. We didn't wait to see what he had to say, but we heard it the next morning. He said what a silly thing it was, and they were condemned cannons, and they'd blow up, and all that. Well, we knew they wouldn't because we shot them again after that. This time, we didn't get them so far out. We tired easily, only got 'em out opposite the chemistry building. And we fired off one of them. And you ought to hear the glass tinkle coming out of that building! It just jerked out. I don't know how. We didn't stop to look at the windows. And we beat it, believe me! They never found out who did it. I'm glad they didn't. We did not say anything about it for years. And the sophomore class had to pay for putting in those windows, for some reason or other. Somebody reasoned that they were guilty, and that suited us all right. That was that.

Well, then, after I graduated, I wondered, "Now, what am I going to do?" I hadn't thought much about what was going to happen after graduation. (I was like the man that stole the Treadwell gold, and I'll tell you about that later.) So here I'd graduated and nothing to do. So I thought I'd go where there s some mines. I graduated in mining engineering, so why not go to the mines?

Well, first, I went over to Professor Johnny Fulton and told him I wanted to take some advanced work, and could I get a teaching

assistantship in chemistry? Well, he didn't think much of my chemistry, and he said, "No." So then I told him I thought I'd go up to Alaska. "Well," he said, "why don't you go up there?" Hame Blue, who used to be a guard on the basketball team, was up there at Nome, and somebody else also was at Nome.

So I got out a map and took a look at these things and found out that Nome was way off around the corner at the far extreme edge of Alaska, up on Bering Strait country. Well, that was too far, and I saw there was a place called Juneau, was the capital, and I thought, "Why not go there for a first approximation?" So I went up to Seattle and bought a ticket to Juneau. (You know, at that time, you could go to Juneau for twenty-five dollars—fifty dollars round trip—and all your meals. I think now they charge you, oh, I don't know, a hundred fifty, two hundred dollars for the same sort of a trip.

Treadwell Mines

So I took the boat for Alaska. It was an old, worn out hulk, the *General Sampson*. And they said it was so old and rotten that they kept the tools on chains so nobody could drop them through the bottom. I guess it wasn't quite that bad. So we pulled into Juneau about midnight.

Well, we stopped at the Treadwell mines on Douglas Island, so the tourists all got off and went through the big mill up there, the three hundred-stamp mill. They had three hundred stamps in one mill. They had about—let's see, a three hundred stamps, and two hundred and forty in another one. They called one the "300" mill and the other the "240." They had two more with a hundred and twenty (that'd make it seven hundred and some-odd) , and one with a hundred and ten. So that's a lot of stamps. And they were pounding away, day and night, except when they were shut down for repairs, all year long except Fourth of July and Christmas. So this mill was running, it was nighttime and in full blaze of light, and we went up there and walked through it, and I was practically deaf for a week afterward.

I went over to Juneau and decided I'd go over to Treadwell and see if I could get a job there. Next morning when I came down to breakfast at the hotel, there were two of my former classmates in mining. One was named Atkeson, the other Carl Jamison. (That Atkeson may be the father or a relative of the Atkeson, the now famous photographer up at Portland, Oregon, because they were Oregon people. This photographer is Jim Atkeson.) They asked me what I was doing, and I said, well, I was going over to Treadwell to see if I could get a job. They said they'd been over and hadn't had any luck. So I went over anyhow and put down my name and visited the mills and went into the cyanide plant.Oh, this fellow was with me, Atkeson, but the other man, Jamison, wouldn't go over with us. He just wouldn't make an attempt.

And so we went over to the cyanide plant, and they had the sign up, "No Admittance." And this fellow hesitated, and I said, "Well, that doesn't mean that everybody must stay out." I said, "We've got business in there."

He said, "What business have you got?"

I said, "I want to go in and see the superintendent."

So I asked for the superintendent down at the bottom of the mill, and they sent me upstairs, and I went up and saw Mr. [William P.] Lass. And a couple days later, he phoned over and asked for two of us to go to work over in the cyanide plant. Well, now, that's where I got double-crossed. Atkeson said that the boss said he wanted to hire him and the other fellow that was over there in the

first place. Well, neither one of those had been in the cyanide plant. He didn't even know either one of them existed until I went into the cyanide plant myself.So I know they shortchanged me. But afterward, I got a job underground as a mucker, and also as a helper on a machine drill.

One of the most interesting jobs I had was when I and a Greek were working on the 1,200-foot station of the Mexican mine, one of the Treadwell group. They hauled the ore out by mule train and dumped it from the cars into a what they called a "grizzly," made out of railroad irons about eight inches apart. We were to break up rocks no thicker than eight inches and no larger than about two feet square, otherwise they'd jam what they called the "skip pocket" when the chute dropped down that they loaded the ore into (they called it the "skip"). Then they'd open a gate, and the ore would fill the skip, and they closed the gate. And then they'd ring the bell and the engineer'd hoist that up and dump it in the ore bin, and at that time, another one'd come down the other shaft, and they'd load that up and hoist that one up. (I afterwards got up above to haul that ore over to a mill. I'll tell you about that later.)

This Greek—of course, I'd had ancient history in college, and so I would discuss ancient Greek history with this Greek. We'd talk about Pericles and Themistocles and Demosthenes and all of the rest of the famous Greeks and pass the time that way when we weren't busy pounding up rocks. And you know, afterward, I wondered about this man knowing all about Greek history. I thought, well, all Greeks knew Greek history. They just naturally taught them all this ancient history, just like they do us, you know, in grammar school and high school and so forth, and never gave it a thought, except I thought it was odd that this miner was so well up on his history. And years afterwards, the thought occurred to me, I wonder if he didn't think about me the same way. Here, he'd met this mucker from Oregon that was up there, and *he* knew about ancient history, and—. But he didn't say anything about it.

I worked at that for a few weeks, and then I got a job helping run a machine drill. I remember one night on a night shift, this machine was pounding away on the quartz, and when the steel would hit the quartz, it would give off light, and not hot—it was cold light. It's a phenomenon with certain minerals, and quartz in particular, that on bruising it or rubbing it, it will give off a kind of yellowish-white light, glows, and it'll do this whether it's under water or out in the air. It doesn't give off any heat, apparently. It's not a case of burning oxygen, but it does give off a very peculiar smell that I've never known anybody who could tell me why that was. This phenomenon is called triboluminescence.

You know, when you're a helper on a machine drill, the machine driller is the boss. He runs the drill, and you do nothing that he doesn't tell you to do. If the drill sticks, why, of course, you can go up and pound it with a hammer 'til it jerks loose, or if he tells you to change the drill, you take the wrench and unbolt the clamp and take the drill out and he swings the machine around so you can put a new drill in the hole. (You put a longer one in as you get deeper and deeper.) And he swings it back around and you put the drill back into the chuck and tighten up the bolts. But otherwise, you touch nothing. Well, I'd been working with him for a week or two, and when I saw this light flashing around the hole I saw some dynamite sticking out [laughing] about two inches away from the hole we were drilling. There was still dynamite in one hole that hadn't completely

detonated. I used to pick up dynamite in the muck many, many times. So I reached up and shut the air off.

And right away—. He was from southeastern Europe. We called them "Bohunks." I don't know what nationality he was. He could've been a Serbian or Yugoslavian, or what have you— Bulgarian. Anyway, he said, "Why you do that?"

And so I said, "Take a look."

So he took his candle and went up there and saw that dynamite, and he says, "Jes' Chri', boy! Jes' Chri'!" [Laughing] And he sank down onto the ore pile. His legs just—you've heard 'em talk about rubber legs. Well, his legs just looked like they were made out of rubber. They just folded up under him, and he must've sat there for about five or ten minutes. And I had to help him when he wanted to get up. He was so weak. It didn't bother me, but it did him. And I thought, you know, it was all in a day's work. So then we moved over a ways and started drilling another hole, off from that one, and I think we pulled some of the powder out.

Well, you know, there'd been some men blown up in that mine where the Greek and I were working, down there at the 1,200 station. They had had an explosion the year before and blew up several men. It killed some that were getting on a cage to go up. And there was a man in with the stope boss getting some caps. Unfortunately, they had a powder magazine right opposite the shaft, and they had caps in the powder magazine. (Of course, nowadays, we have rules and regulations that a powder magazine can never be near a shaft, and you cannot keep the powder and the caps within so many feet of one another. And you cannot bring any powder underground, except just enough for that shift. The rest has to be all left up above ground.) And you could still see a mold around on the rocks where they had been atomized and scattered.

I remember before I got the job at Treadwell, I took a trip up to near Mendenhall Glacier. I was walking. I didn't go all the way to the glacier; it was too far. And coming back, I saw Indians spearing salmon. I thought they were Negroes. The Indians up there are very, very dark, and I thought they'd come in on some ship and were up there spearing salmon. They're very dark. They were Tlingit Indians. (It sounded pretty much like some of the Aztec words. You know, the Aztecs have a lot of "tl's" in their language.) And their speech was very guttural. I don't see how you could represent it like we do the European languages and Romance languages because they would make such odd noises. I remember one night in Juneau, I'd gone down to see a ship that came in, and I was walking back up to my room. Two Indians came up behind me, and they were talking, and I thought they were two men that were drunk and were just about ready to vomit. So I sidestepped and got out into the street and let them pass. And they went on up talking that way. That's the first time I'd ever hear people talk so guttural as they did—most odd sounds.

And then I went up a creek—I can't think of the name of it now—with a man who was surveying it. They afterward put in a power plant and he ran a survey up there. Over at Treadwell, we used electric power, and water power, and steam power to run the mills. When the water power was low on the island (Douglas Island), they went over to electric power coming in from the mainland, and coal for steam. And when they got plenty of electric power, they shut down all the steam boilers because the electricity was the cheapest power. But I've seen one mill up there operating on electricity, steam, and water. This was the Bullion mill, which was about a mile south

of the Mexican. It was also located within a few hundred feet of Gastineau Channel. The water was the cheapest, of course, and they had enough electricity for a little of it, and they added steam for the rest of it. That was the only mill that used any water power. The rest were all steam or electric driven.

I remember one night, the governor broke on—I guess on the steam engine—and it raced at full speed until the fly wheel burst and pieces flew around and hit the water heater that supplied hot water for the boiler. And the concussion caused the water in the boiler, which was way above boiling point because it was under high pressure—and it flashed into steam and sheared of f all the bolts that held this big boiler (two and a half feet in diameter and about six feet high), and it shot right up through the roof and arched over and came down on the beach of Gastineau Channel, an inlet from the Pacific Ocean.

I got through working underground—that is, I got fired, believe me! When I first went to work, the old foreman looked at me and says, "So you're a college man, are you." And ground it out through his teeth, and I saw I was in for it, right then and there. They didn't care much for college men in those days. Some of them don't yet. And so he fired me later, after a few weeks. I don't know why; he just fired me. I says, "Why do you want to fire me?" And he found an excuse.

I was telling you about quartz. The first job I had was shoveling up quartz ore into a wheelbarrow and running it over—it was way over to the side of a stope, probably one hundred feet—and ran it over to the ore chute. We dumped it down that chute. And you could see as plain as day from the light given of f by that quartz hitting one another and rubbing along. That was the first time that I had seen quartz do that. I'd read about it in a mineralogy book, and I thought it was very, very rare. And you know something? Many mineralogists still do. A very famous mineralogist at one of the large eastern universities, when I was doing graduate work back there, he called me in one fall and had me go into a dark closet. And he said, "I want to show you something." And he rubbed two pieces of quartz together and he said, "Do you see that?"

I said, "Yes."

"Well," he said, "you don't seem to show much interest."

"Oh," I said, "I'm interested, all right. But it's a very common—."

He said, "That's quite a rare phenomenon."

And I said, "I beg to differ with you." I said, "It's a very common phenomenon."

"Oh, no!"

"Well," I said, "when I was at Treadwell, Alaska, all their quartz was triboluminescent." And I said, "My son, Vincent (just about five years old then) goes down in Central Park and gets quartzite pebbles because it'll do the same thing." And I said, "This summer (that was in 1928), when I was out at Nevada City with Professor [Hans] Close (he's from Bonn, Germany) and Robert Balks, also from Germany," I said, we went down Wolf Creek to a mine about a half a mile down below town, and they had a dump there with tens of thousands of tons of quartz in the waste dump. (It was probably the old Champion mine.) And it was about sundown, and we spent a lot of time rolling boulders down that dump just to see the flashes of light.

"And also, there's a place out in central Nevada, out near the brucite mine, where there's a tungsten mine in dolomite. One of my students told me that he worked in that tunnel, and if you left anything in there, all you had to do was to go in and pick up a hammer and pound on the wall and get enough light to illuminate it well enough to

see. You didn't have to take a light with you. Of course, it only illuminated while you were striking it with a hammer—just a flash and die down. But you kept pounding on it, and it kept up enough light for you to see all you wanted to see.

So here was a man, a professor of mineralogy at a very noted institution, that had the impression that triboluminescence was very unusual. And the way it's put in textbooks, it seems to give people that impression.

Well, then, back to my story. I got a job in the cyanide plant as an operator and later as a chemist. We worked eleven hours on the day shift, or thirteen hours on the night shift, day after day, and only got off Christmas or Fourth of July. And from that mill high on the hillside, you could look across Gastineau Channel onto Sheep Mountain that was coated with ice, and in moonlight it was a beautiful sight to see. The moonlight on that Sheep Mountain, on the ice, and the wind came roaring down off Taku Glacier, which is over in that direction. That's where the icebergs came from that floated up the channel occasionally. And when we went up to Alaska, the ship went in there, and they stayed about a mile away from the glacier and [they'd] blow the whistle, and great, big slabs'd fall off.They told us they used to go up closer, but one ship went in there some years before and blew the whistle, and the whole front of the glacier fell off and almost swamped the ship. That's Taku Glacier. (A lot of 'em up there call it "Tarku." They always like to put an "r" in words. I guess they're New Englanders. They used to call our place *Horncut*.)

I was going to tell you something about the gold brick. This is a real gold brick. It wasn't pure gold; it was only about five or six hundred fine. And we discovered, working up at this mine, in the cyanide department—. All the gold produced at Treadwell came through our cyanide plant because we took the gold from the stamp mills that was recovered on amalgamation plates (which are copper plates plated with silver), and then mercury applied to the silver. And after it was mined, the ore was crushed in the stamp mills and the pulp splashed out through 20-mesh screens and flowed over the mercury-coated plates. And when the mercury became hard —you could tell from feeling it whether it was beyond recovering more gold, or if it was soft enough, you knew it would still take up gold (that had to be learned by experience). And when it got too hard, they shut down the mill and washed off all the pulp and scraped the mercury amalgam off with a scraper so as not to injure the silver, and then sprinkled new, more mercury on, and go from there. And you had to know when to stop sprinkling it on; otherwise it'd run off. Then it ran from there over through vanners (and they were a slowly moving, inclined rubber belt with edges on them—little sideboards, you might say), they vibrated sidewise, traveled very slowly, had little streams of water running down over them, and that washed all the tailings off, which went out into Gastineau Channel, and the concentrates went down into a box—over a roller in a box full of water, and that washed the concentrates off.

Then that was shipped up to the cyanide plant, and we cyanided this concentrate. And the mercury amalgam that was scraped off the amalgamation plates, was put into a press and forced out through a canvas bag, and that which stayed in the canvas was put into a retort and heated and made into a solid brick of gold. The mercury that was squeezed out of the bag was used as is. But when you retorted this amalgam, the volatized mercury had to be condensed. That would be condensed and it was used over again.

And then that came up to the cyanide plant, and we ran the gold they would ship up for us to refine in the melting room, and we'd add that to the gold that we recovered from the concentrates. That gold was shipped down to Selby smelter.

Now, the cyanide plant had been running for two or three years, and they were short about $150,000. They didn't know what became of it. They knew the value of the ore that went in, and they knew the value of the tailings that went out onto the dump, and the difference ought to be the amount of bullion, supposedly, that they shipped to Selby's. The reason they shipped it to Selby is because they made more money than if they shipped it to the mint. If you ship it to the mint, and the bullion is not absolutely pure, they'll charge you for refining it. And the cost is such that it pays us to ship bullion only about five hundred or six hundred fine than to get it up to eight or nine hundred fine— I mean, eighty or ninety percent pure. The purer it is, the higher they charge you for freight, for insurance, for refining—all that. And so there's a cutoff point. We found that around five hundred, six hundred fine (that's about fifty percent, sixty percent fine), we got more money back than we would with a finer material.

So, they were short this $150,000. The boss decided, I don't know why, to make great, big gold bricks that nobody could steal. Nobody had stolen any, but he just got a notion in his head. I don't know why. The ship only came up there about twice a week, something like that, and all you had to do was to see that nobody went on board, and they kept an eye out for that, that nobody stole the bullion. They had to go on the ship, and they couldn't get off the ship. You could send a cable down and stop them.

Well, anyway, he decided he'd make big bars. We were casting bars that weighed, oh, about fifty or sixty pounds. He decided that he'd take all the gold that came in two weeks' time—I think it was about $250,000 to $300,000 worth. It only takes, let's see, I think at that time it took about $700,000 to make a ton. So you can see that if you put $50,000 or $60,000 into one brick, it'd be a pretty big brick. He had a mold made that was about three inches wide at the bottom and about three and a half at the top, seven inches high. It was about sixteen or eighteen inches long. I haven't stopped to figure out how much the gold weighed, but it weighed a couple hundred pounds, anyway—maybe three hundred. They cast this one bar, and it was so big and so awkward to handle that they had to finally send down for the track gang, and bring up these big tongs they had for lifting railroad iron and put four men on that, and it was all they could do, kicking each other on the heels, to move it from there into the refinery. Talk about being ridiculous! Then we had to hoist it up onto a truck and get it out onto the railroad track to ship it downhill to the railroad, and then over to the ship.

Well, when they got it to Selby smelter, they got a letter back that, well, it was pretty bad reading. They had to saw that bar all up before they could put it into their furnace. It was too big to go in their furnaces. They let us know about it, right now. And they shipped no more like that.

There's another little story comes along on top of that. There was a lot of gold shipped to Selby smelter—not only ours, but a lot of others. And they had several vaults that they stored the gold in until they refined it. When they got it thoroughly refined, of course, they shipped it to the United States Mint. One morning, they opened up a vault,

and it was Treadwell gold that went into this vault—several hundred thousand dollars' worth—and they opened the vault—no gold! The bottom of the vault was about half inch steel. [There] was a round hole there that somebody had bored holes from below and cut out a piece of metal, and all the gold was gone. So they went looking around outside to see what could become of ft, and they finally found, out by the coal bunker, that there was a big tobacco sign tacked over an opening. And they tore that off, and there was a tunnel, and the tunnel went right into this vault. They were no time at all finding out that the temper had been drawn out of the steel, and the bottom of the vault was bored full of small holes during the night, and the gold had to be taken out through that hole.

And immediately, they thought, "Well, what was the night watchman doing all this time?" They called him up and wanted to know where he was. Well, his excuse didn't sound very good, so they went up to his room, and they found his overalls with the sand and muck on them, just like was in that tunnel. They found the lamp that he used to heat up the steel to draw the temper out of it, and they found the drill with which he drilled the holes in the bottom of the vault, and so they naturally asked him what he did with the gold.

Well, he 'fessed up.They finally promised him to let him off with a lesser sentence if he 'fessed up and helped them out on it, which he did and they did. I think he only got fifteen years or so. I don't know what they could've given him if he hadn't 'fessed up. Well, if he'd just sat tight, they'd been out that gold, period. I don't think they'd've ever found it.

What he did, he told them that he'd been working for months digging that tunnel. lie carried the dirt out in his lunch bucket and in his pockets, and he very carefully scattered that around the smelter when he was walking around and on the dump, and so forth, where it wouldn't show up. When this gold came from Treadwell and they put it in that vault, he'd be all set to get it out.

So he went in there and drew the temper out of the vault, bored the holes, took out the piece of steel, reached up in there with his hand, and threw down a bar of gold off the pile and carried it out past the sign. It was a moonlight night, and he stepped out into the moonlight holding this gold bar. And then the thought occurred to him, "Now, what shall I do with that?" He'd planned everything beautifully, see? So he said he stood there holding it for a while, and he couldn't stand there forever. Somebody might come around. So this thought hit him, that, well, he'd go out onto the pier and drop it off into the mud in the bay. So he did that, and he took a hatchet and cut a notch there so he knew where he dropped it over. He didn't look very far ahead there, either, because he'd've never got it out of there. Anybody'd go out there at the dredge picking up this, they'd immediately want to know what they were doing.

Well, that's where the gold was, in the bay. So they got a clamshell dredge and picked it up, and everybody was happy for ever after, except this poor devil that was sent to San Quentin. They tell me a lot of these crooks are not very bright, and I guess that goes to prove that that one wasn't. I laughed more over that thing. That happened after I left Treadwell, but I was interested in it because it applied to the Treadwell mine.

By the way, Treadwell lost those mines in 1916. You see, the cost of mining at all was very cheap, probably about $1.50 per ton. And if they had ore that ran over two or three dollars a ton, it was bonanza ore to them and anything that went above that was pure

profit. Well, there was a bend in the vein at a place called the Seven Hundred Foot clam. We called that the "700" mill, and I worked in the Mexican mine, which was further south. Right in that bend was very rich, high-grade ore. Now, that was right out under the water of Gastineau channel. And there was a tailing pond right over the top of it. So a new manager decided to work that high-grade ore. Everybody else had left it because there was salt water would leak in there—there was places where salt water would leak into the mine. And the other manager didn't want to mine that for fear it would break in.

Well, they started to mine it, and it started caving. And finally, they put a man, a watchman, out there to watch the level of the water in this pond, and told him if that settled at all to give the signal underground—a certain number of flashes of light—for everybody to get out. And fortunately, the man happened to be watching at the time this thing happened, and he saw the water drop and then stop. Instead of asking anybody any questions, he gave the alarm. Well, a good many people probably would've waited for a second one. That would've been too late. Because it did cave in, and the ocean water rushed into the mine. The mining engineer (who afterward went back to the mines at South Dakota), he and the tool nipper (the man who takes tools and drill steel in and out of the mine) were the last ones up the Treadwell shaft. That shaft is up on the hill, a hundred feet above sea level, and the force of water passed them [laughing] it shot up—shot up over the head frame. So if they'd been a little bit later, they wouldn't've made it.

Then I left Alaska because my father was ill and I went home to Honcut. They told me I'd better come home because Father was—he wasn't seriously ill, but they figured he might be. And then when I got to Portland, I met a classmate there who had received a cablegram from home telling that my father was quite ill. So I hurried on home from there.

That was after I had been up the Columbia River, clear up past Hood River, and up to about the Dalles, where the falls are now. Anyway, there was a mission right there at the time Fremont came there in 1843. There was a Methodist mission and also one up above, at Whitman, near Walla Walla. (Whitman was murdered by the Indians shortly after Fremont came through there.)

And by the way, you know, it's only been in recent years they discussed recent volcanism in the Cascade Mountains. I think it's Mt. Adams—just north of the Columbia River. Fremont said when he came through, he stopped at the Dalles and left his crew there while he went down to Fort Vancouver and back again. And the missionaries there gave him some volcanic dust—ash—that had fallen three or four years before, which would make an eruption about 1840 when that big mountain up north was erupting. And it's only been in recent times that geologists have realized that those mountains have erupted in very late time—in historical time.

My First Trip to Nevada

They built the sugar refinery over at Hamilton City. I remember them building it about 1904-'5. And in 1912, I applied for and got a job as sugar chemist when I came down from Alaska. I was on my way up there to take the job, and I had to change trains in Marysville, and I went down to the hotel between trains (which was a wait of several hours), and my father was in the hotel, and he said, "Where are you going?"

And I said, "I'm going up to Hamilton to the sugar factory."

"What are you going to do?"

I said, "I'm going to be a sugar chemist."

"Well," he said, "how would you like to examine a mine for me?"

And I said, "Where is it?"

He said, "Over in Nevada."

"Oh," I said, "fine."

He said, "I'll give you a hundred dollars to examine the mine." (Somebody got him interested in this mining property.) So then I went to Nevada. That was my first trip to Nevada, and I went over to examine the mine, went down to the south end of the Pine Nut Mountains, got a team in Gardnerville in the livery stable, and they drove me out to the mine, about twelve miles. I told him to come back for me day after tomorrow, because I figured it'd take the next day for me to examine the mine and property, and find out what I wanted to do so he could come after me. Well, I found out that very afternoon. I saw all I wanted to see and took all the samples I thought were necessary because there wasn't any sign of quartz; there were just a few bleached areas, and I told this man to show me the best ore that he had in several different places, and I sampled the best. (You know, you should do that. If you go to sample where you think it looks pretty good and you don't ask them, they'll always claim that you never saw the best ore.) So I asked him for the best sample. And then he had some assays he'd gotten from an outfit from Denver, Colorado, that ran gold and silver for fifty cents a sample. Everybody else charged a dollar, so you could figure that anybody who charged fifty cents, they probably weren't doing very reliable work.

I stayed overnight at his place, and while we were talking after supper, he told me that any of the rock around there would carry values, and I said it didn't seem possible.

"Oh," he says, "you can go outside and get any rock, and I'll show you."

So I went out to get a piece of rock. It was dark, almost, and I could hardly see a thing. And I thought, "Well, now, I wonder if that fellow has salted up all the rocks near the cabin here?" (Salting means adding valuable metal like gold to valueless material.) And I'd go out and pick up a salted rock and—sure to get gold out of it. So I went out and got a rock that was firmly embedded in the ground, and I shook it real hard and it broke loose. I got it loose and pulled it up, and trimmed off with my hammer the best I could, so I know that nobody could have salted that rock, and broke off the bottom piece and brought it in.

We ground up enough, about what would make a half assay ton—that'd be about fourteen and a half grams. I was used to assaying, so I knew about the amount, and we put it into a glass, and he put some mercury in with it and stirred it all up, put in a little soda to make it alkaline, and shook it up, panned it down, got the little globule of mercury off, put it in a teacup, put nitric acid on it and dissolved the mercury. And, lo and behold! there was a little dark grain at the bottom, which I thought certainly—black material, I though, certainly was gold. We put it on the lid of the cookstove and it turned red hot, and when it cooled down it was bright yellow. So I knew it was gold. had done a great deal of assaying and knew what it looked like. I judge it ran about easily a half a milligram, so that would be about an ounce per ton. And I just couldn't believe it.

During the night, I'd wake up once in a while thinking about that, and wondering where the catch was. It finally dawned on me that his mercury contained gold and silver. I don't think he knew it. A lot of these people used to buy mercury. They'd get mercury that'd already been used for amalgamation, and it'd been squeezed through a chamois bag, and so it still contained considerable gold and

silver. So the next morning, I said to him, "Let me see that quicksilver."

So I poured about the same amount he had in the teacup. It dissolved it with nitric acid, I got the little black bead. I heated it up on the stove and it turned yellow, and I said, "There's your gold."

Well, the next time I was out in the Pine Nut Mountains, a good many years later, I went out to examine a copper mine. I can't remember the name of it—a Blue-something-or-other, because there was a lot of blue copper minerals there, blue azurite and green malachite. And I also went out there to look at the tungsten deposit at a later time, and also examined a silver deposit—I sampled that one, at the lower end of the Pine Nut Mountains, one called the "Veta Grande," meaning the "Big Vein." It had some very good ore in it, but it was very spotty and practically no depth to it.

From there, I went up to Virginia City, my first time to Virginia City, and went down into the Con Virginia shaft with the old superintendent, I guess the last one that operated at the Con Virginia when it was open. (His name was McCormick, and his daughter married the young man that runs the bar in Virginia City now, called the Crystal Bar.) And we went down to the 2,800-foot level in the Combination shaft. Wow, it was hot in that mine! (And, of course, I rambled through the mine when I was teaching at the University of Nevada many, many times since then. We'd go down the Union shaft and walk over. Con Virginia was caved. We'd walk around clear over to the east Yellowjacket shaft, and over to the Alta shaft, which is at the extreme end of the north lateral of the Sutro Tunnel. And that's where we got the name—the Alta andesite was named from this Alta shaft. And there was a great deal of Sutro tuff down in there. And the water was up about to our armpits. So we'd walk along with a stick and sound out ahead [so] as to be sure we didn't step into some deep workings. And then there was a branch from that ran over to the Foreman shaft, but I never went over to the Foreman. I went part way, but it looked too wild in there to suit me. What we mean by "wild," you know, is loose rock and rotting timber, et cetera.)

I went out to Nevada Hills after visiting the Comstock Lode and examining a mine in the south end of the Pine Nut mountains. I wrote for a job out at Nevada Hills mine and got a reply: they had a job for me in the assay office. I had done assaying before, and I helped the assayer there. And from there, I went up and worked in the refinery, where we melted up the silver bars from the zinc precipitate from the mill.

You know, in order to recover gold and silver from ores, the ores are treated by the cyanide process, with cyanide in solution, and this solution dissolves the gold and silver in the form of a cyanide compound, and is precipitated out of solution by the addition of zinc, or aluminum dust (and there, we used zinc). Then that zinc precipitate is dried and mixed up with suitable fluxes and melted up and reduced in the furnaces in the refinery in graphite crucibles. And it's poured out as bars of silver. Those up there weighed about a hundred and twenty, or thirty, pounds, and they were shipped down to the refinery.

Then after working in the refinery for a while, I took a job underground running a machine drill and worked for several months until the place I was working in became very unsafe, from my standpoint. But the foreman thought it was perfectly safe. I always had a philosophy of working underground: if some man there told me that a place was unsafe, I took his word for it. If he told me that it was safe, I used my own judgment because you

can't be too careful underground. I've been in some serious situations underground.

When I was at Nevada Hills, Royce Hardy was mine superintendent. He worked for Wingfield and worked for the Goldfield Consolidated Mining Company for a long time after that. We also had an engineer there by the name of Jimmy Greenan, who afterward went to the Philippine Islands and was quite successful. And then he had interests in the dredge that operated south of Battle Mountain at Copper Canyon. And he sold out his interest there to a dredging company that operated f or some time. And that dredge, I believe, was brought up there from Manhattan, where the dredge had operated. There was very little dredge operation in Nevada. There was those two and the one that I told you about before, at Gold Canyon. There may have been others, but those are the only three that I know of where bucket dredge operated.

Nevada Hills was strictly a silver mine. There was some gold in it, and some lead, zinc, and copper, but mostly the value s in silver. And they went down to, oh, about seven hundred feet, maybe a little below in places when the values of the ore gave out. Nevada Hills was discovered way back in 1906 or '7 during the big gold excitement in the early 1900's, following the discovery of Tonopah and Goldfield. And it was the only mine; there was a great many other claims around there an sporadic mining activity. The Nevada Hills mine was a consolidation of two or three properties, and was at an elevation [of]—I don't know, six or seven thousand feet up on the side of Fairview Peak. And we had a train at that time that ran to Fallon, and people going out there would take the train to Fallon; and from Fallon to Fairview, they'd take the stage. There was a gasoline automobile driven as a stage out there (because that was about forty miles from Fallon).And all our supplies were brought in by freight teams—ten, twelve horses drawing freight wagons. The stage would come up to the town of Fairview, which was down below the mine about a mile. It also went on north to Wonder. The freight trains (horse teams) came around through another canyon that was a more gentle grade—a lower grade. They hauled our supplies up there and we had a hotel and boardinghouse and quite a few buildings where people lived up at the mine, although some lived down in Fairview and walked up to the mine.

It closed down, oh, a few years after I left there; I don't remember just when. They pumped water from Middlegate up to the mine. Maybe Mr. Hardy told you about that, because he knew a great deal about the operation of Fairview. And at the same time, a mine was operating at Wonder, about twelve miles north of there. Wonder was a gold mine. It was much more productive than was Nevada Hills, much more profitable.

I mentioned something about the water. Water was pumped to the Nevada Hills mine from Middlegate because we had very little water; we had some water in the mine, but not enough to operate the mill. So they pumped the water up from Middlegate, which was about, oh, I would guess three, four miles away.

And the big earthquake that happened in 1954 was along a fault—well, there was two earthquakes that were about five minutes apart. One was along a fault up in Dixie Valley, which was north of Fairview Peak, and the other fault was on the east side of Fairview Peak, ran from Wonder south to Fairview Peak and then on for another ten or fifteen miles. And that was very interesting, that earthquake, because they had an earthquake in 1915 on the fault south and east of Winnemucca, the fault about—well, one was

about twenty, twenty-five miles long that was mapped by Professor Jones in the fall of 1915, and another was mapped again along in the '30's by Ben Page, who is now professor of geology at Stanford University. And then, in 1932, there was an earthquake east of Mina, and there opened up a series of faults for a length of about thirty-eight miles. And they were mapped by Professor Eugene Callaghan and myself. Then, this one in 1954 practically connected those two breaks with a series of faults, extending for, oh, I forget, twenty-five, thirty miles, but making in all a distance of about a hundred and sixty-five miles of faulting in thirty-nine years in a region where we had no history of faulting prior to that time. You see, I did quite a lot of work on earthquakes.

I took a few days off from Nevada Hills and came to Reno and up to Lake Tahoe, and there had been a cloudburst down the Truckee River Canyon and buried the railroad track. And they had another one down there in 1925 that buried the track again, and I guess it was buried at other times, too, by cloudbursts down in that neighborhood. You know, that'd be down about Painted Rock, or this side, west of Painted Rock.

Nevada Hills bullion was shipped down to Selby smelter for refining, and the concentrates, I think, were shipped there also.

What was it like living there? Well, [laughing] it's like most mining camps were in those days. Nowadays, people would think it was terrible. Back in those days, we thought it was fair enough. We weren't too enthusiastic about it, but it would do. We had very good food and plenty of it. And we didn't think the living conditions were too bad.

I remember one man that we met there. His name was Harry Shipkey. He was an Englishman, and a remittance man from England, and he'd done a lot of pocket hunting on the Mother Lode in California. He died, oh—I don't know—ten, fifteen years ago down in Tonopah. He must've been a very old man at the time he died because he was much older than I was, and I knew him at Nevada Hills, and I was in my late twenties then. He lived up 'til along in the '50's. Oh, he must've been way up in his nineties. Anyway, he was a pocket hunter. That was the man who would go out and prospect along veins for a real high grade ore, where you could get out several thousands of dollars worth of gold ore in just a small space, which, for the lack of a better term, we call "pockets." (I suppose a rose by any other name would smell just as sweet.)

So he would tell us how he found these pockets. And he told us a great many other things about his idea about veins in Nevada. He said our veins seldom went down over a few hundred feet and they gave out. And the reason they didn't go any deeper was because they were low grade veins to start with, but the values were enriched by oxidation of the surface and redeposition of the values down below. I was very much interested in what he had to say. Most of the other college boys wouldn't listen to him very long because they thought he was rather, oh, visionary. But I didn't see anything visionary about him. And it so happened that a year or so later, our leading book, and the first real progressive book on ore deposits came out, written by Professor [Waldemar] Lindgren, who is still regarded as one of the real great geologists. And Lindgren, for the first time, or at least brought it to the general attention of geologists for the first time, many of these very same things that Harry Shipkey was telling us out there. Harry got it out of his own reasoning.

It's astonishing how many men you'll meet in, well, what we consider or what is commonly spoken of as "lower" positions

or "lower" occupations. it all depends on who's looking at it, whether they're lower or higher. But you meet some very remarkable people, and some men with exceptionally good minds, like the Greek I told you about at [laughing] Treadwell, and so forth. But I have met some men in "menial," so-called occupations, that had real fine minds. Now, why they were working at what they were working at, I don't know. Many different things could've governed that. Maybe they like it better there than they would anywhere else. Anyway, there were some wonderfully fine people. So it shows that I have not too good an opinion of some people that I have known who occupy very, very high places, and a very good opinion of some people that occupied some rather inferior, so-called, positions. For instance, some of our most outstanding people, as you know, came from very humble beginnings. Of course, one of the outstanding examples, you know, was Lincoln.

I was going to enlarge something on what Harry Shipkey was telling us about ore deposits. I said something about secondary enrichment. [Reading from notes] Now, the enrichment of some ores occurs during oxidation and weathering of outcrops as they are being eroded—removed by erosion. Some metals, such as silver and copper—and also gold, under favorable conditions—are dissolved and carried downward by surface waters. They are precipitated at depth. This secondary ore is often much richer than the primary, or original ores. When mining gets deeper, then the secondary ore is frequently found in the remaining veins too low in values to be extracted at a profit. On the other hand, ores may be of sufficient richness, or if economic conditions are favorable, that they may be profitably mined to greater depths, as the Mother Lode and Grass Valley veins in California, gold mines in South Dakota, and especially the gold-bearing conglomerates of South Africa, which are being mined to extreme depths. Apparently, enrichment from the surface had not effect on the riches of these mines; that is below shallow depths.

Professor [Waldemar] Lindgren geologically mapped much of the gold-bearing mountainous regions of California, and he published on the mines there and also those of other states. One of his outstanding publications of interest to us here is the United States Geological Survey professional paper on the Tertiary gravels of the Sierra Nevada. He did a great deal of mapping, and he got out the special paper on these ancient gold-bearing gravels.

Skip Alexander's mine on Wilson (or Dale) Creek in southern Butte County, which I mentioned earlier, is about two and a half miles northeast of the village of Honcut. And here is a channel of gold-bearing river gravels of Tertiary age, as I know. No detailed study has ever been published on these gravels, so far as I know. These gravels are in the low foothills, and they range in elevation from two hundred to seven hundred feet above sea level, and they have been neglected in further study because they were low in gold content, and the deposits of gravels were not very large. And hence, there was very little mining by underground methods. The largest mine in the area was known as the Blue Lead, so called because of the dark bluish color of the gravels. And the neighboring creeks and gulches were extensively mined in the early days due to their concentration of the gold while eroding the old gravels. They also derived some of the gold through the erosion of local gold-bearing quartz veins. Some of these quartz veins had been mined to shallow depths by underground methods. None of them had a large output of gold. In the 1920's and '30's,

some of the local streams were extensively mined by dragline-dredge methods.

At Nevada Hills, that was the first time I had ever been out on the desert, and it struck me—struck me as a very weird and isolated spot. I felt extremely isolated, almost like on an island in the middle of an ocean. And the lavender-gray sagebrush stretching for miles and miles in the distance. Yeah, if was a very weird experience. However, afterward, I became so accustomed to it that there's no place I've ever been I liked better than Nevada in lots of ways. And that very isolation is one of the things that is appealing.

Mining in Tonopah, Nevada

Then I left Nevada Hills and worked sampling placer deposits on Gold Canyon near Dayton. There's a large deposit of gravel that was deposited near the mouth of Gold Canyon, coming down from the Comstock and Silver City, which was a gold region. And there're other old gravels down there, probably from the Carson River, which were very low grade. And we sampled those, and part of them were afterward dredged, not too successful an operation because of the large boulders present. And while there, I experienced some of the worst thunderstorms [laughing] I had ever gone through, right there at the little town of Dayton. We had terrific thunderstorms!

Leaving there, I went down to Yerington and I worked in some of the copper mines in the vicinity of Yerington during the summer. And from there, I went down to Tonopah in the fall of 1913. I worked at Tonopah into the fall for several months—I forget just how long.

At Tonopah, I ran a machine drill for a time in the Belmont mine. Here, again, [laughing] the foreman seemed to object to the fact that I was a college graduate, and so he told me, he says, "I have a damned hot place for you [laughing] down there." So I thought I might as well be hung for a wolf as for a lamb, so I told him I was a past master at working hot mines, Of course, I wasn't. Most of my mining was done on the eleven hundred-foot level of the Belmont. My first job was in the Number Nine raise, which was very hot, and the air was very poor—all that foul air. It was up about eighty-five feet above the level and it had evidently been worked on by many miners without putting in a round—that is, a boring a round the holes—eight or nine to a round. There were many holes started that ran to a depth of but a few inches. Of course, these miners'd take a job and go down there and do that, fiddle away for an hour or two, and then go back up, and they got paid for a quarter of a shift, even if they just went underground and out.

The timberman visited me after my first shift and told me that I would not last long. Well, I believed them, but I bluffed it out. I put in a round of eight or nine holes about three or four feet deep, and in the meantime, the maintenance men came around and cleaned out rock from the air pipe that was supplying ventilation so that I got some fresh air to breathe. When I went out to the powder magazine to get my thirty or more sticks of dynamite, and also fuses and caps, the powder man would not at first believe that I had put in so many holes because so many real miners had given it up after a short try. So I loaded up my holes, carried my powder up the raise and loaded up the holes and spit the fuses (which means lighted them), and at about eleven-twenty went down to the station and waited for the cage to take us up the shaft. Soon, my shots started to go. The miners waiting at the station counted them up. Finally, one said, "They've got a miner [laughing] in Number Nine this time!" [laughing].

Tired and almost exhausted as I was, I got quite a lift from that remark. I worked but a few shifts in that raise when the engineers discovered that I had driven that raise up for about twenty-five feet above the next level. So all my work had gone for naught. (You know, it was higher than the level when I started in on it. I drove it up another twenty-five feet, which was utterly unnecessary.) And several shifts were worked breaking ore in a stope nearby, and several other shifts in driving another raise. Finally, the foreman told me that I had not broken enough rock to bury myself, although that was not the end sought in driving this raise. I realized that he was leading up to finally firing me. However, I beat him to the punchline by saying, "She's deep enough, and I'm going on top," which meant that I was quitting the job. "She is deep enough" is a miner's expression for intimating that he is through—that is, making the mine any deeper.

I did some odd jobs on the surface, such as helping out in the mills at cleanup time. That was when they removed the silver precipitate from the cyanide solution and reduced it to silver bars. I spent some time doing assessment work, the annual labor necessary to hold ownership to located claims. I worked at that for some time on these lode claims lying to the northwest of town.

I met Jay Carpenter there. Jay Carpenter at that time was superintendent of the West End mill. And I met quite a few other interesting folks—I don't recall who else. But one odd thing that happened there, I went up to their gymnasium and was playing basketball. I didn't have any regular gym suit, so I put on my swimming suit. And it struck me as odd. Those youngsters there, you know, never saw a pool of water deep enough to swim in, and during an intermission, one of the youngsters about twelve, fourteen years old came up to me and said, "Is that a swimsuit?"

And I said, "Yes."

He said, "Can you swim?"

And I said, "Oh, yes."

And he went back and he says [laughing] to the other boys, That man can swim!" [Laughing] I thought, it's an odd commentary, just to think, you know—.

It reminds me of another instance, too, about water scarcity. When I worked out at the Nevada Hills mine, water was very, very scarce out there until they put in the pipeline from Middlegate. And then they had plenty of water. Before that, it was very scarce. We used to collect the water from the rain off the roof. And, of course, out in the desert, we didn't get much rain. And we were very careful about using our water. And even after washing in water, we'd use the water to water the trees or plants around, were very careful of it. So when I took the stage back to Reno, we passed some place, and some woman came out and took a bucket of water and threw it [laughing] right out onto the lawn. And I almost jumped out of my skin to think of people who were so *wasteful* of water. Just imagine! Throwing a whole bucket of water just like nothing! I finally got used to that. But it shows the impression it makes on one.

Well, there wasn't much that was said about what was going on around Tonopah, because, you know, a miner works all day and he's mighty tired, and he's glad to rest and sleep the rest of the time. I remember one day, though, I was up in a brokerage office, where they bought and sold mining stocks. And evidently, some man around town decided that he hadn't been treated right by the broker, so he came in with a big .45 caliber revolver, waving it around. And I immediately got behind the safe. The door of the safe happened to be open, so I got behind that door until this excitement died down. I thought that'd be fairly good protection in case bullets started

to fly. But nobody got shot, and so he left, and everything turned out to be all right.

As work was scarce, I decided to go elsewhere, probably into Arizona. So I bought a ticket for Goldfield because I thought I'd like to look the town over. But when I got to Goldfield, I started to walk up the street, and I just didn't like the looks of the town. I don't know why, but it didn't appeal to me. So I thought I better check and find out when the next train left because I didn't want to probably be stalled in Goldfield for twenty-four hours. So I went back to the station and asked them when the train left for Arizona. And they said, "In about twenty minutes." So I bought a ticket for Kingman, Arizona and stayed over in the station 'til the train left.

Mining in Arizona

Then I went down to a junction in the station of Ludlow out on the Mojave Desert, where this railroad, the Tonopah and Tidewater, joined the Santa Fe. And we got in there about ten o'clock in the evening. The train was supposed to come in at eleven, and they kept postponing the arrival until it finally did get in, about five o'clock in the morning. So we caught the train into Kingman, and I ate breakfast in Kingman about ten o'clock. And I hadn't had any sleep all night long—I guess two nights. So I went over to the Beale Hotel. (The Beale Hotel was named after Lieutenant Beale, after whom the Beale Air Force Base up here at Marysville is named, and who afterward held a large ranch down near Cajon Pass in southern San Joaquin Valley. And Beale, as a lieutenant, went over to Arabia and brought over the Arabian camels that they were to use on the desert. They thought the desert, recently acquired by the United States in the war with Mexico [1846], would need camels to transport material. Well, the camels were a failure in this country. And they also brought some dromedaries from northern Asia. Now, they were a different breed of animals. And they finally turned them all loose on the desert. They used some hauling salt to Virginia City, you know, from the salt flats. Anyway, Beale brought these camels over, and they named the Beale Hotel for him.) Well, I went to sleep at the Beale about twelve o clock, and I thought I was just getting soundly asleep and somebody came pounding on the door and woke me up, and I asked them what they wanted, and they said, "Well, it's eight o'clock."

And I said, "Well, what's wrong with it being eight o'clock?"

"Well," they said, "we thought you were dead in there."

"Well," I said, "dead?! Oh, wait a minute," I said. "Is it eight o'clock in the evening or in the morning?"

They said, "Eight o'clock in the morning."

And here, I slept clear through, from ten o'clock 'til this man woke me up next morning. So I jumped up and dressed and went down and had breakfast and rushed out to the stage because I was thinking of going out to Goldroads to work there, or an old mine out at Tom Reed—the Tom Reed gold mine, out at what is now known as Oatman. (The Oatman mines were discovered later. They were a few miles from the Tom Reed.) So I talked to the stage driver a while and decided that probably the chances of getting on out there weren't too good anyway, so I told him, well, I'd been out in the desert long enough. I thought I'd go somewhere else. So I went back and went over to the depot. Of course, I was ignorant about the geography of Arizona. I asked them where was the next nearest large copper camp, and they said, "Jerome, Arizona." So I told them to give me

a ticket for Jerome, and that's the way I wound up in Jerome. Well, so much for that.

Then I went down to Arizona to the United Verde Mine and worked with the electrical force, and then later with the surveyors and engineers. And I had some wonderful experiences there underground.

These mines were originally worked as placer mines because they carried gold. On the oxidation of the copper, it would be ultimately dissolved out of the outcrop, or a great deal of it would be dissolved, and the gold would be set free as metallic gold. It formed the placers in the gulch where the town of Jerome now is, on the north side of Mingus Mountain. They placered up to the outcrop and discovered that there was a vein up there [which] carried gold, and they erected stamp mills, and for a while operated as a gold mine. And then, when they came down into the copper ore, they put up smelters and smeltered the copper. From that, it developed into a large operation.

At the time I was there, the mines were about 1,400 feet deep, and there were big fires burning down to five or six hundred feet. They had to put the mine under pressure. They had about four pounds air pressure in order to hold the burning gases and fire back in the rock so that people could work there. And some places, they had to wear masks—"air masks," as they called them—where the air blew in and blew the sulfur dioxide away from the men's faces so that they could breathe. And that was only in a few places.

Then, they brought Spaniards down there from the copper mines up in Shasta County above Redding. They had fires at Shasta County, too, and in order to work these burning mines, they sent to Rio Tinto, Spain, where they had had fires from time immemorial. The Spanish were good at working burning mines. So they imported Spaniards to Shasta County, and then later from Shasta County down to the United Verde. And these Spaniards were expert at that sort of thing (of course, we were perfectly willing that they should).

I remember about midnight, there was a great blowing of whistles, and we knew there was a fire at the mine. So most of the people who were off work went up there to help out if they could, and they were hoisting men up from underground. A lot of these men, as soon as they got to fresh air, they would collapse for some reason; I don't know why. I guess they were breathing smoke and carbon monoxide, which is very dangerous because monoxide weakens you so you feel tired and you want to sit down. The miners called it wood smoke. And once you sit down, you can't get up because your muscles are so weak that you can't support yourself. Once you sit down, you're through.

They finally put that fire out. And I had some experience in the fire stopes because I went in there with the electrical crew to furnish lights so they could go down into the workings and have light to work with. [Laughing] They'd go down in the smoke, and we couldn't even see through it. I don't see how they lived in that.

They actually, at one time, sealed off a part of the mine and flooded it, and left it flooded for several months. And then when they pulled the water out, the mine would take fire again within a few days. So fires underground are very difficult to control, especially in sulfide ore. See, they give off sulfur dioxide fumes that are suffocating; they could easily kill one. And they were tremendously hot. There were places where the rocks were so hot they used cast iron posts for timbering caps instead of wood because the wood would take fire. And the mine cars were so hot that if you touched them with your bare skin, you'd get badly blistered. I went into one

place near a fire stope to run a survey with another man, and it was so hot and humid in there (the temperature was around 135° and the humidity was a hundred percent), that the glue in our notebooks melted and let the notebooks come apart. So we put them outside and wrote our survey notes on mine wedges—wooden wedges. There was a little cloud of steam in the upper part of the drift, and if you got your head up into that vapor, you couldn't breathe at all. So you just had to feel around for the stations to survey by, to connect your plumb bob to.

I was very much interested in one stope where these Spaniards worked. Whenever we surveyed near there, we usually went around and watched these fellows. They would go down a winze into the burning stope (workings). It had to be perfectly dry when they went down into this burning stope, otherwise they would blister. They'd go down and they'd draw out a carload of waste from the waste chute and run it out on the end of the rail and dump it. And the timbers were on fire down there; they just glowed like the end of a cigar in the dark. The temperature—I don't know what the temperature was, but extremely high. And then they'd come out of there into the drift, and they'd be just the color of a red beet. They were red—florid, red color. These Spaniards were light complexioned men. They were blond. A great many of them were quite blond, and some of them had red hair. They looked more like Norse than they did what we would consider the average run of Spanish. Then, as they sat around in the drift a while, the color would gradually change and fade away until they became, well, rather a pale color. Then their faces would start to get glossy and the perspiration'd come out, and then, finally, it would just run off in streams. I never saw so much water run out of people. It was quite an experience to see them go through this. They would have to stay up there in that drift until they were absolutely dry before they went back again. And they'd only be down in this heat for about ten or fifteen minutes, and they'd stay out for probably two hours. I never went down that hole, but I've been in some pretty hot ones.

Before I got onto the surveying, when I was still with the electrical crew, they had a fire in the mine. Well, they always had fires, fires burning all the time, but sometimes, they were worse than they were others. And we were called out at midnight because at the Number Five shaft, they'd had an accident and stripped out the guides that held the ore skips that hoisted the ore out of the shaft. They were torn out for several hundred feet down below the five hundred foot level. And so we went down to reestablish the electrical wires that were torn out, and while we were down in the passenger compartment, the hoist (where they hoisted men), we heard the men down below coughing, and I could smell sulfur gas. And a few minutes before that—maybe five or ten minutes—we'd heard some blasting in the mine, and I imagine the blasting had liberated this sulfur gas. And so, I could smell it, and when I heard these men coughing, I told the boss that we'd better go down and get those men and take them out because it was so bad that they'd probably suffocate. Well, they finally called up to us to come down and get them, and we lowered the cage down. Two of the men got into the cage with us, and the other man, who was up higher, up in the shaft, crawled up on the hood of the cage and held onto the cable. And the signal was given to hoist, a "slow" signal, as we call it. They hoisted it very slowly, and I thought we would never reach that five hundred-foot level. We finally did, and got out, and the men rushed over to the fresh air that came in on the five hundred-foot level. The man up above, I had

to help him down. [Laughing] I don't know how much help I was. He probably weighed two hundred and fifty pounds. I weighed about a hundred and twenty, but I tried to help him, at least. And then we crawled over to fresh air, and I thought I would never breathe, but I finally did. Had we stayed down there a few minutes longer, well, that'd been that. That was one of the most serious things I experienced underground.

Then shortly after that, I went on the survey crew. They were going to change over the whole mine. They had been building a smelter down at Clarkdale, which was on the Verde River, about six or eight miles down below us, and, oh, probably a thousand feet lower in elevation. Jerome was at about 5,200 feet elevation, and the Verde River was probably a thousand feet lower than that, fifteen hundred feet. So we had to arrange to lower all the ore in the mine down to the thousand-foot level. They ran a tunnel out from the thousand-foot level to the surface to connect with a railroad that would take train cars underground and take them out from there to the surface, and on the surface, they would connect up with the steam line that would take them down to the smelter. So we'd transport the ore by rail all the way from the thousand-foot level on down to the mine smelter at Clarkdale. (Clarkdale got its name from the main owner of the mine who was Senator [W. A.] Clark of Montana, a former senator.)

So we had to drive raises from lower levels up to the thousand-foot level, and also raises from there to upper levels, to drop the ore down to the thousand-foot, or hoist it up to the thousand-foot level. It was quite an experience running these surveys in order to get these works to connect up closely with the upper levels. Some of these raises were a hundred and fifty feet or more in length. Then we had to survey this long tunnel on the thousand-foot level. That finally was all connected up and put into operation. And the mines operated 'til they got down to, I believe, about four thousand feet before they finally shut down. Now all that is gone. The smelter at Clarkdale has been dismantled also.

While I was at Jerome, they were also prospecting north of the town because of a faulted portion of the ore. A long time ago, after the ore was deposited, the country was bevelled off and was covered over by a series of marine sediments, some of which were as old as Cambrian in age. They were quite fossiliferous. These were faulted down about a thousand feet or so, along a big fault that extended along the front of Mt. Mingus. And they realized that there should be an ore deposit down there, not only an ore deposit, but a very enriched one, where the weathering and erosion of the original ore deposit had been dissolved and reconcentrated, so there'd be rich copper. When that was faulted down, then the present ore that was exposed up on the mountainside was oxidized (as I described previously). Well, they spent several years looking for this ore deposit. And they finally found it. It's called the United Verde Extension line. And their ore ran as high as forty percent copper, practically all copper sulfide—chalcocite. (And their stock was selling for something like sixty-five cents before the ore was discovered, and afterward went up as high as forty-two dollars, and they paid almost that much in dividends.)

That ore was shipped down to the Verde River near Cottonwood at a town they called Clemenceau, after the famous Frenchman of World War I. They built the smelter at Clemenceau and smelted this high grade copper. And that mine lasted for a long time. They had about five hundred feet of this very enriched ore that had been faulted down

off of the top of the United Verde ore shoot. That was quite a triumph in engineering and geology, the locating of that rich ore shoot.

While I was at Jerome in the fall of 1914, World War I broke out, and the price of copper dropped to practically nothing because most of our copper was being shipped to Germany. So the mines were closing down, and we were notified we'd be laid off in a month. I decided that I would leave earlier and go down to the University of Arizona and do some advanced work. I studied geology at University of Arizona and also took engineering astronomy. My professor in geology was Professor Clapp, who afterward was president of Montana University. And I had a professor in psychology by the name of [Rufus] von Kleinschmidt, who was afterward president of University of Southern California for a great many years. And in astronomy, I had Professor E. A. Douglass, who made quite a reputation because of his work on studying out history from tree rings. He was the leader in that line of work—the originator, rather, I believe. He taught us engineering astronomy so that we could determine time and longitude and latitude and true north to survey from. I found him a very inspiring teacher. He was also responsible for getting a gift for the University of Arizona, and he established an astronomical observatory with a twenty-six-inch reflecting mirror. He had a series of pictures of the phases of the moon taken on twenty-eight consecutive days, which he published and liked to show to illustrate the wonderful clarity of the Arizona skies and the good seeing that they had. And that work, no doubt, led later to the establishment of that famous observatory now on Kitt Peak in Arizona, which operates in conjunction with the University of Arizona and other universities.

There's always an end to all good things [laughing]: I ran out of money and had to go to work. I heard there was a position open for a chemist at the Calumet in Arizona, a smelter down at Douglas, Arizona. I decided to apply for the job, but first, I thought of writing, and then telephoning, and then later I thought no, maybe it's better to be on the job. So I caught the midnight train out of Tucson on the El Paso and Southwestern Railroad and got in to Douglas about seven o'clock in the morning. I had a quick breakfast, went out to the smelter, and made an application for the job. The chief chemist excused himself, said he had to go over to the main office for a while, and he came back and told me that I had the job, and that the way I got the job was being right there and applying for it. They phoned up to Bisbee and told the other man not to come down (who would've taken the job had I not been there). So I spent the day out at the smelter getting on to the run of things. I caught the train back at about four in the afternoon, hustled my things together, got back onto the midnight train, back to Douglas, went to work next morning at eight o'clock. So at the end of that day, I was pretty tired, being two nights without sleep [laughing].

Well, I worked for the smelter, I don't know, about a year and a half as a chemist. And we had to run things so much differently than we were taught in college. Because in college, we were taught to be exceptionally careful, which was a good idea, and very deliberate. But we never could use those sort of methods commercially because out there, you had to move along and get a lot of work out. And we were able to do that sort of thing. Sometimes, we would run, oh, I don't know, fifty or sixty different determinations in a day. I know we used to run eight or nine coppers—cyanide coppers—on the mattes and slags

from the smelter; that is, from the copper smelters themselves, blast furnaces as well as reverberatory furnaces because that was a check on how the work was coming along. Then we had the regular ores, about fifteen or twenty of them, that we had to run, gold and silver, copper, silica, iron, aluminum, calcium, and occasionally some other things, so that they could know how to distribute these ores in the smelter yard. These ores were crushed and sampled and then spread over a long dump. They had to know how much silica or lime, or whatever was lacking in the ores, had to be added to them. And then after this was stacked in the yard, then they had a machine that raked that down, and on a rubber belt, it was conveyed into the bins in the proportion to feed the furnaces. And so our work had a lot to do on the control of these furnaces.

Also, we had to assay the copper bullion for gold and silver, and presumably for copper. Yes, we did run the copper. But we knew we couldn't do any better than they did down at the refinery. It ran ninety-nine [point] nine-something percent pure, anyway. And it ran about forty ounces in silver and contained an ounce or so of gold to a ton.

Also, there was a great deal of gold and silver, copper, was lost out of the smokestacks. You talk about contamination of the air, we ran tons and tons of sulfur up those smokestacks. And the sulfur was so strong that it killed the lawns in Douglas. Every time the wind blew across the lawn (the lawn was damp), it cut—you didn't have to mow your lawn. This just cut it right back down to the bare earth.

There were some people in Los Angeles who made a specialty of getting the sulfur fumes out of the stacks. They used a method—electrostatic method—where the dust was precipitated on wires in the stacks, and then these wires were shaken every so often. This dust was molded up in briquets and fed back into the smelter. And our manager was rather peeved when he found out some of the results they were getting because it was learned that we were losing about $1,500 a day up those smokestacks. And he was irked because—well, here we had a nice metallurgical balance, as he called it. We accounted for everything—everything that came in and everything that went out. Then, here we had this $1,500 going up the smokestacks that nothing was accounted for. Well, they probably put in a recovery process there. Later, they used this waste—fumes—by recovering the sulfur dioxide out of the fumes and using it to make sulfuric acid that the company used over at Ajo, at a big mine there that had mostly oxidized copper ore, so that the copper occurred as azurite and malachite, which are the two common oxide minerals. (They are carbonates, a mixture of carbonates and hydroxides. One is an intense blue, where it got the name of azurite, and the other's called "malachite" and is a beautiful green color. They're soluble in sulfuric acid.) So they ultimately made tons of sulfuric acid and sent it over to Ajo to use in their leaching plant there. (By the way, Ajo got its name from the wild garlic that grows in that neighborhood. And *ajo* is the Spanish word for garlic.)

They also used the waste heat. You see, during a smelter operation, there's a lot of heat goes up the stacks and is lost in the atmosphere. And so, at about that time, or a little before, they put in what they called "waste heat boilers." And these waste heat boilers took this wasted heat, that used to escape to the atmosphere, and used it to generate steam. And over at the Copper Queen smelter nearby, they sent that power up to Bisbee to help operate the mines up there. They also had

an excess that they used to sell to the town of Douglas to light the town and what power we needed around there. They also exported some about forty-five miles down into Mexico to the El Tigre mine, which was a very rich gold mine. And during thunderstorms, which we had some very severe thunderstorms along in the summertime —July and August—the lightning would hit that line and come in and jump the circuit breakers at the smelter, which made a beautiful display of flashing lights.

Oh, by the way, the smelter not only supplied power down into Mexico, but the Copper Queen Company also had a railroad that ran down into Mexico about sixty or seventy miles to a place called Nacozari. It was called originally Pillares de Nacozari because there's some large plugs of rock stuck up in the air there they called pillar, or a pillar. And Nacozari's the name of the town, and they operated a mine, and had for a great many years, mining copper ore that they shipped up to Douglas to smelt. Well, that's about all of that for the smelter.

And, of course, a lot of these things I learned down there at the smelter were advantageous to me when I took graduate work at the Mackay School of Mines because I'd analyzed these ores, and I'd see them go through the smelter and knew what happened to them. So it meant that metallurgy of copper was much more meaningful and more easy for me to acquire than if I hadn't had this smelter experience, or other experiences in underground mines, like my experience I had at Treadwell and Jerome and other places. There's nothing like practical experience, if you want to do technical work afterward.

There were numerous gila monsters and scorpions around Douglas. And the youngsters in school—little youngsters, eight, ten years old—used to go out and capture these gila monsters. They had no fear of them at all. They used to pick them up by the tail and drag them around just like we would nonpoisonous lizards.

We had some very interesting experiences there. I worked there for much over a year. And we had some bad accidents at the smelter. Some men got badly burned, and one man lost his right arm—he survived, too, strange as it may seem.

They had a good many raids of the Mexicans across the border. They would raid into America and steal stock. They had soldiers stationed along the border; they had some at Douglas, Arizona. Finally, we used to hear the cavalry out at the military post just outside of town. And we'd hear them racing and chasing around out there at midnight and off toward Slaughter's ranch, which was about, oh, twelve miles or so to the east of Douglas. And when the Mexicans would raid over there, we'd hear gunfire and then all would quiet down. Then a few days later, the paper'd come out and say there were several soldiers that were injured in target practice the day before.

This was the beginning of the 1916 trouble. Villa had come over and attacked the Mexican town across the border, Agua Prieta. And they fought there for three or four days, and we used to go down and watch them fight at night, when we were off shift, and see them come up close to the trenches and fire on the town of Agua Prieta. They kept that up for about three days, then they left and went off to the west, and a copper company sent them out a lot of supplies to sort of buy them off from raiding the Green Cananea Copper Company, in Cananea, Mexico. Then they went over to Nogales, and they got into a fight with the American troops over there. There was one hundred thirty-four Mexicans killed, although there was nothing in the paper about it. We heard that by word of

mouth, and I didn't see any account of it 'til I was up in Reno years later, saw a little squib in the paper about a hundred and thirty-four or -five Mexicans having been killed at Nogales several years prior to that.

The Mexicans of Agua Prieta burned up the bodies of the dead soldiers down in Mexico after the Villistas had gone westward. They stacked them up and put petroleum on them and burned them—partially cremated them. Made a horrible stench in Douglas, I know. And the way *their* Red Cross operated—they sent men out over the battlefield and shot all the wounded that were lying out there. We could see that from up on the smelter stack, looking down into Mexico with binoculars.

An interesting thing—this Slaughter's ranch, east of Douglas—I didn't know it at the time, but it was right on the site of the big earthquake of 1887, which was probably the strongest earthquake ever felt in the western United States. I had the pleasure of investigating that earthquake on two trips. I flew over it one time and then went down and spent two days by car, and found a great many interesting things about the effects of faulting that produces earthquakes—the effects of faulting on the surface—and found a great many things that had never been described before as far as I know. (Of course, I didn't take up the work on earthquakes 'til after I got to the University of Nevada.)

I left Douglas because I came down with an attack of hepatitis; I turned as yellow as a lemon, so I was home to recuperate from that. And then, I got an offer of a position with the Southwestern Engineering Company in Los Angeles, doing flotation test work. I worked for them for quite a while —couple of years, I guess—and I finally left there for the pay was very poor.

I took a job with a mining company at Hackberry, Arizona, out in Mojave County, east of Kingman about twenty-five, thirty miles, but this didn't last very long because the company went bankrupt (it was a promoter operation). So I returned to Los Angeles. Coming back, I drove—I left Chloride, Arizona, at four o'clock in the afternoon and drove all night long, only taking out time for meals, and got into Los Angeles at noon. So I was twenty hours on the road. You can imagine the kind of roads they had in those days—no pavement, just a lot of chuckholes. Twenty-five miles an hour was high speed and rough going.

Southwestern Engineering Company

Then, Southwestern Engineering Company hired me back again. I told them I would work for them temporarily. They gave me an increase of about thirty percent in salary, and so I worked with them 'til along the next June, because I decided to go to Nevada or Utah.

Well, we did a great deal of experimental work on flotation [at Southwestern Engineering]. Among those things were—oh, I did the first experimental work on ore from the rich silver ore from out at the old mining camp in Kern County. It was from the Kelly mine in the Rand district. It was a very, very rich silver mine. It was discovered by some men who were doing assessment work. And in coming back to their car, they decided to sit down on a mine dump to eat their lunch. And while they were eating it, one man started breaking open some of the rocks on the dump. And he found they were rich in ruby silver. Whoever sank this shallow shaft apparently didn't recognize ruby silver. So those men found' out who owned the claim, and they bought it, very reasonable (they had a lawsuit over it, too, because they got it very cheaply and made considerable money out of it).

And my bosses, Lou Penhoel and Dewitt Bisby were going up to a mine that they had north of Trona, and they'd seen these dumps, just out there in the field near the road, and thought nothing of them because you see a great many prospect pits all over the world. And after this discovery was made, they brought some ore in and I ran some flotation tests on that ore—you know, just as a matter of information. I also ran the first flotation test made on the ore at Tybo, Nevada. So, I ran some tests on these Tybo ores, and these were highly oxidized ores, rich in copper carbonate. And I was able to float copper carbonates moderately successfully. I think f if] we'd gone further into that, we could've been first in the utilization of those ores by flotation, but we didn't go any further.

I also invented a ball mill for them, a laboratory ball mill, which became very, very widely used afterward, made by Braun-Knecht-Heimann, and discovered that ordinary crude fuel oil (it was very cheap and very high in sulfur) made a very good collector for sulfide ores. And my company organized a subsidiary company to sell this crude oil for flotation and made quite a lot of money out of it. I think I held five percent in the company for discovering that. (The discoverers always wind up on the short end of the deal, just like Columbus did.)

Well, I had this very fine experience because flotation in those days was comparatively new. This was back in the late 'teens, and flotation was just coming in then. And it was a wonderful field for discovery of new methods and new reagents and just a lot of things. And then, after we ran experiments for people, ofttimes we were sent out to start their mills up and to put them into proper operation. Well, that's the way I came to go out to Hackberry (I told you about it), was because we had sold them some machinery and I went out there to operate their mill for them.

Another interesting experience I had was, I used to always pan down the ores before I ran them, and I also panned the tailings to judge about how good the results that we were getting. And that's always a very important thing, to do that sort of work; I mean, panning to judge the value of the ores. In so doing, I found in one ore that was sent us from Baja California, it was a copper ore in a contact metamorphic deposit, contained garnet, proxenes, et cetera. And I found that the vein contained considerable scheelite, or calcium tungstate, a very worthwhile tungsten ore. So I suggested to these people that they might have a placer deposit of tungsten below the outcrop, which it turned out they did. So they put up a mill, and they bought a concentrating table. Oh, I can't think of this man's name that invented this concentration table. Anyway, because I recommended the table, he gave me fifty dollars of unearned increment because of recommending his table.

Well, I consider that my work at the Southwestern Engineering Company was very, very valuable to me in my later work because it gave me an opportunity to see a great many varieties of ores—gold, silver, lead, copper, zinc, molybdenum, tungsten, what not—and many, many more ores than I'd had an opportunity to work with otherwise. Well, that's about all I can think about at the Southwestern.

My Family

Now, I'll tell you something about Mrs. Gianella's forebears. Her grandparents were people of Germanic background—German immigrants in their twenties. They had

migrated to the eastern United States during the 1840's, which were very hard times in Germany. Her maternal grandmother was Martha Fredericke Schade, who married a Mr. Breitung. They were married in New York City, and they'd come to America in the 1840's. They had one child, a boy, and Mr. Breitung died from an injury received in an accident. The widow, Martha Schade Breitung, married George Helmich; they lived in Sandusky, Ohio. George Helmich was killed in the battle at Gettysburg in July, 1863. He was a cabinetmaker by trade. He was a member of the seventh regiment of the Ohio Volunteers. The widow Helmich had a child by Breitung, George Breitung, and she had four girls from her marriage with George Helmich.

Now, Lydia Helmich was Mrs. Gianella's mother. She attended German Wallace College in Berea, Ohio, preparing to become a missionary to China. And after two years' study, she lost her hearing due to a cold. Now, on the doctor's suggestion, we went to Denver, Colorado, thinking that the high altitude would help her hearing. And after a year, she went to Los Angeles to visit her sister, older sister, whose husband was a minister of the German [Methodist] Church. Then Lydia Helmich returned to Sandusky. However, she was charmed by southern California, so she used to make quite a few visits out to it. And while in Ohio, she attended Baldwin College near Sandusky, whose president was Joseph E. Stubbs, who was later president of the University of Nevada, which we learned years later, after we had moved to Reno.

Lydia Helmich met William Charles Thiele in Los Angeles in 1884 while she was visiting. She returned, however, to Sandusky. Mr. Thiele (they pronounced it Tee-lee) was born in Brooklyn, New York in 1859. And when he was twelve years old, he went back to Germany with his father for a visit to the old home at Sandershausen, which is now in East Germany. And he sold out his Brooklyn property and moved to Germany with his wife and two sons and daughter. And while there, William Thiele attended a boarding school in Dresden, and he majored in civil engineering with a minor in veterinary science because his father had determined he was going to raise some animals on his ranch. And after ten years in Germany, the family got homesick for the United States and returned here and settled at Beaver Dam, Wisconsin. After several years of farming, they moved to Los Angeles, California, where William Thiele entered the medical school in Los Angeles and graduated with the first class in 1888. I think that's the medical school now that's a part of USC. He entered practice with Drs. Henry Worthington, Karl Kurtz, and a Dr. Shorb. It was shortly after this that William Thiele became very ill with typhoid fever and was confined to the hospital for several weeks. And Lydia Helmich, hearing of this, came out from Sandusky to Los Angeles, and they were married in 1888, shortly after Mr. Thiele left the hospital.

Catherine Thiele, Mrs. Gianella, was their first child, was born October the fourth, 1889, on North Broadway, near the site of the present Hall of Justice. Their youngest daughter, Augusta, was born in Los Angeles in 1891. They had only two children. Catherine graduated from high school in 1908, and Augusta graduated in 1909. Catherine graduated from the Los Angeles Normal School, now UCLA. I don't know the year in which she graduated. She taught country grammar school in Ventura County, California, and later in Douglas, Arizona, where we met when I was employed as a chemist at the Calumet and Arizona smelter.

We were married at Catherine's home June 27, 1917. Our first child, Faith Mary, was born May the fourteenth, 1918. We moved to Reno in 1919, when Faith was a year old, and bought a home on Marsh Avenue. Our second child, Catherine, was born there in Reno on August the twenty-eighth, 1919. And our third and last child, Vincent II, was born January the fourteenth, 1922.

Back in 1919 or '20, I went over to Downieville, and while there I bought a gold bar pin for Mrs. Gianella. And it was about an inch and a half long, and it had, as I remember, four or five nuggets of graduated size. And I paid—oh, it was nothing compared to what it'd be worth today, probably seven, eight, nine dollars—I don't know. And one of the nuggets had little pieces of quartz in it. And at that time, I could have bought a great deal of gold over there at—oh, about the price of bullion; that is, if I had the necessary money. I knew a man there that had quite a large collection of gold, as a matter of fact. There were quite a few men in the Sierra who spent much of their time a placer mining.

Well, anyway, Mrs. Gianella wore this bar pin and was very fond of it. We went to New York City for graduate work after I finished a year at Yale. And one evening, or one day, she went downtown with our son, Vincent, on a shopping expedition. I guess she took a streetcar downtown—I forget —and came back on the subway and took a taxi from the subway over to our place. We were living then on Morningside Drive overlooking Central Park in New York City. Oh, we lived just about a block from President Butler of Columbia University. And I came home from school, oh, late—late at night. I usually worked quite late studying over there or doing laboratory work. And I got home, oh, I should judge eleven, twelve o'clock at night. It was a moonlight night. And Mrs. Gianella was very upset because she had lost that bar pin. So I said, "I'll go out and look for it." Well, she said she'd looked up and down the street for hours and she couldn't find it out there, looked all over the house, all over the apartment. She knew she'd lost it on the trip somewhere.

So I went out, and I spent, oh, I guess about an hour, and finally a policeman came along, and he watched me for a while (I was still looking up and down the street). He wondered what I was doing out there. He wanted to know, of course, and got suspicious. And I told him I was looking for a gold bar pin with nuggets on it, knowing that he wouldn't know what I was saying anyway. (Reminds me of the time I brought some [laughing] index liquids back by ship and tried to come through the customs station down at San Pedro, and they wanted to know what those things were, and I told them they were index liquids. Well, I might as well've told them that they were, oh, something from the nether regions. They had no more idea of what index liquids were than the man in the moon. Anyway, I finally got them through all right.)

So, when I was talking to this policeman, and I was out in the street and he was on the sidewalk, I told him it was a bar pin; it was a little gold pin with nuggets on it. And, of course, I knew he didn't know what I was talking about. So I came back over to talk to him. He was on the sidewalk, and I raised my foot to step on the curb, and then, right under my foot was this gold pin.

Now, where did it come from? I know it wasn't there before because I'd looked up and down that curb many times. And that was right where the taxi stopped in front of our building. And there had been two taxis come up and stop in front of the building while I was out searching around. One of those taxis

must have been the taxi that Mrs. Gianella rode in. And whoever got out of that taxi at that particular place kicked that bar pin out. Now, that bar pin may have ridden for thirty, forty miles over New York City during all those hours. And here, somebody would kick it out at the place where it belonged. Now, you talk about strange things. I imagine that was one chance in, I don't know, millions, or what not. But it did happen.

3

Graduate Studies and Field Trips, 1919-1928

So we got into Reno, and we spent some time looking around Reno, and I decided that I would stay in Reno and go to the University there.

In 1912, I had first visited the University of Nevada and the Mackay School of Mines, and I met Professor George J. Young, who was then the director, that summer, and had a talk with him. And that's all I knew of Young personally, except that he left there and became editor of the *Mining and Scientific Press* in San Francisco, and was editor for a great many years, I believe up 'til 1920, '21, or something like that. He published a text on mining which was highly regarded. And he was very good, very artistic, in copper etchings. He was well known in art circles for his work there. Francis Church Lincoln was director of the school, and then John [A.] Fulton became director in the early '20's. And while I was away at graduate school, Jay Carpenter came to the school as professor of mining engineering to take the place of Professor Lincoln. And we had Professor Walter Palmer, who taught metallurgy, and Professor William Smythe, also in metallurgy and mining (Bill was a gold medal student and basketball player when he went to college; he graduated from the University of Nevada, I believe, in 1914).

I started doing graduate work at the University of Nevada, Mackay School of Mines, in 1919. I decided to get my master's degree there, which I took in mining under Professor [Francis Church] Lincoln. I think if Professor [J. Claude] Jones had been there, I'd've taken it in geology. But I felt at the time I had a better background in mining that I did in geology, although as I had mentioned before that I decided—I don't know when, shortly after I got out of college—that geology's what I liked better than mining. So I used to read about the geology of all the places I visited, if anything had been published on it. And long before I went back to college, I had read, oh, a tremendous amount of works on the geology of Treadwell and the geology of numerous other places. So I had a pretty fair background.

Then, when I went to the University, Professor Jones was not there. He had not returned from Battle Mountain, where he

had spent much of the summer in consulting work for the copper mining company which was operating at Copper Basin south of town. And so I took my work—research work in mining—for my master's thesis, which was on the sampling and assaying of free gold ores (that's where the gold occurs as the metal, native metal), and the sampling of which is a very difficult job, and almost impossible—some cases it is impossible to get an accurate assay result on free goldbearing ores. The ore came from Allegheny [California], which is noted for their rich gold mines, pockety gold mines. (There's one gold mine still operating, I believe, in Allegheny. It was shut down in the fall of 1969. And we have several students go to Allegheny to work in the mines there. A man [by the] name of Bennett, an old University of Nevada man, operated, was general manager—Dick Bennett, we called him. He operated the mines over there for years and years, and very successfully so, until he operated the Sixteen to One mine, which was a combination of the Sixteen to One and the Tipener mine and others; it was not very profitable. They had very rich gold ore and, oh, some of the samples were really—I guess you'd call them fantastic, for the lack of a better term. They were gold specimens the like of which you rarely see, and they must've had fifty or sixty thousand dollars worth of gold specimens in a certain building they had up there. They were sold afterward to somebody over in Grass Valley, I believe. So Bennett operated that mine.)

In studying there, I think I got much more out of those classes under Professor [Walter] Palmer and got better grades in them for the fact that I had seen a good many of these operations out in the field, and I'd done a great deal of analyzing of the ores, and saw them smelted, and the end result, and how the slag came out of these furnaces and ran into what we call "settlers." And the matte, which is a combination of copper, carrying gold and silver and combined with sulfides, and being heavy, it settles out of the slag and these settlers. And after it has run from the furnace into the settlers, after an hour or two, they can draw the slag off, or ofttimes, the slag runs off while they're pouring it in and the matte settles down to the bottom. After a while, the matte is drawn off the bottom of the settler, and still molten, taken over to the converters. And the converters blow oxygen through there and oxidize out quite a few impurities that pass off in the slag, and get rid of a great deal of iron, too, that goes off into the slag (those slags are very rich in iron). And the copper comes out, then, in a fairly pure form, called blister copper, and that's shipped away to the electrolytic refineries, which produce practically a hundred percent pure copper, and the gold and silver falls to the bottom of the electrolytic vats, and is recovered separately.

So I had seen those blast furnaces operate, and also the reverberatory furnaces, which operate on the sulfide ores—rich suit ides—concentrates, and so forth. (They call them reverberatory furnaces because the flames reverberate, striking on the melt and then up to the ceiling of the furnace and then down to the bottom and so forth, as it passes on through. And they're a hundred and twenty or thirty feet long, and they turn out a high grade matte, which goes to the converters.) And then I had experience with the roasters they ran there to roast the high sulfide ores. That drives off the sulfur, and that makes a very high grade sulfur that was used to manufacture sulfuric acid.

So I had the opportunity of seeing all of those operations [at Douglas, Arizona]. You see, about every third Sunday, the different chemists took turns going out to the smelter

and running certain determinations of copper on mattes and slags and so forth, that had to be done. And we got Sundays off. So if some man had to go out on Sunday to run these determinations, they'd take the results over to the smelter foreman so he could know how his furnaces were operating. And while we did that, then, we got a chance to look around and see how the smelter operated. While we were working, we didn't, because our time was all taken up in doing our work. We just came and went to work; when we got through work, we went home again. But on Sunday, when we had to do that other work, we got a chance to visit the smelter and reverberatories and so forth. So it was quite an experience.

What was Dr. Lincoln like? Well, Lincoln was a somewhat peculiar man, a New Englander, with a strong English accent. He was a tall man, rather stooped, and rather thin. You see, Lincoln had got his doctor's degree at Massachusetts Institute of Technology. And he took a job down in Mexico—no, not Mexico, South America—and he went up to the high elevation, as so many of the mines are, down there in Peru, and he had a very severe case of mountain sickness. And he also suffered from some violent fever. I don't know just what this fever was that he contracted in Peru, and it made him very thin, and I think he suffered from the effects of that the rest of his lifetime. And the students used to kid about him a whole lot because he had an English accent, like he'd speak about "sinking a shahft," and so forth. But Lincoln was quite a highly qualified man. I believe that most people who belittled Lincoln greatly underestimated his ability and his background. But afterward, after he left the Mackay School of Mines, he went to the South Dakota School of Mines, which was a very famous mining school, and taught there 'til his retirement. I happened to see him once or twice after he had retired from Nevada. He got out a very fine book on the history and production of mines of Nevada. And when they revamped it many years later, the [laughing] director at that time didn't want Lincoln back to finish up the book, which was a terrible mistake, because he would have done a fine job on it, no doubt about it. We didn't have very many men at the Mackay School of Mines that could write creditable papers—I mean, with good English and good reading and so forth. (Maybe we didn't have any, so far as I know [laughing].) But Lincoln wrote well and was a highly accomplished man, well-educated man.

Professor Jones was an exceptionally fine teacher, a good lecturer, a very sympathetic man, very much liked by his students, although he was by no means easy on the students; he was a rather strict man. He had a way of lecturing in more of a conversational way and made his lectures very, very interesting. He was one of the best teachers I ever had.

I might also mention, while I was teaching at Nevada, I took a course from Professor Frandsen, Peter Frandsen, in evolution, and I thought he was a remarkable teacher. Peter Frandsen could've taught in any university and been a credit.

So could Professor John Gottardi. I took a course from him in Spanish, a short course, and he was a most excellent teacher. Now, I had taken language from three, four —I don't know how many others—five different teachers other than that. See, I took some Spanish at Oregon State. I think I took a year of Spanish. I took a semester, I guess it was, of French, down at the University of Arizona, and I took French and German, summer course, at University of Minneapolis. And I took a course on technical German when I was at Yale in order to become proficient enough to read scientific French and German, which I—at one time—could do fairly well.

And it was necessary to have those in order to get your doctor's degree, to be able to read technical French and German. And I found it very handy afterward because I could use textbooks, particularly petrography and mineralogy, in French or German. But of all those language teachers I had, I had none that were anything as good as John Gottardi. Well, now, so much for graduate work.

I taught at the University in '22, but there was no record of that. Professor Jones employed me to teach some courses in, oh, blowpipe analysis and mineral determination and that sort of thing. And then in '23, I started to teach —I taught fire assaying of gold and silver, also some in ore dressing, and I taught some geology classes. I had a mixed load—some in geology, some in ore dressing, some in assaying, both in metallurgy and geology. After that year, I taught geology only.

Then it was decided that the faculty should go away and take refresher courses. They decided that I should go first, being as I was the newest member on the staff. And as it turned out, I was the only one that went away for refresher courses. That was perfectly agreeable to me if I would be allowed the time to complete my work for a doctorate. And that was agreed upon. And so I wrote to, oh, a great many different institutions in the East. Professor Fulton was very strong for me going to some school here on the coast, like Stanford or the University of California. But I didn't care for that because I'd been brought up on the coast and all my training in geology had a strong bias toward the geology of the West. And then I knew practically all of these professors and was supposed to be, I guess, their peer or coequal in a sense because I was teaching at the University of Nevada at the time. And I didn't think that would be just the right sort of an atmosphere for me to do graduate work, under teachers who knew me also as a university teacher. And also, I wanted to know something about eastern geology, and get their thoughts, or their ideas, on geology.

You know, in natural sciences, the tendency is naturally, to concentrate on things that are in one's own neighborhood. Like there in the Appalachians, they had great thrust faulting of the mountains and great thrust faults of which we knew little or nothing at the time in the West, which is rather funny, because since that time, we know we have greater thrust faults out West and in Nevada than ever was dreamt of back in the Appalachians. However, I would've not got that background by studying on the coast. I was very glad to go East, and I selected Yale because of some of the professors there who were outstanding men in their work.

I might tell you something about our trip East, which was quite enjoyable. There was no paved roads in those days in Nevada. There were no paved roads in Utah, nor Wyoming, nor most of Nebraska; the first paved road we got was in eastern Nebraska, just a few miles out of Omaha. And then we had paved roads for the rest of the way east—well, not all the way, but most of the way. This was in June, '25.

The first day, we only got beyond Fallon. We got a late start. We camped out near Sand Springs, and the mosquitoes were terrific—not as bad as some we met later. And then, the next day, we made Austin. We camped on the summit just beyond Austin. Now, this sounds like slow traveling, but if you will consider that we had three children with us, and every evening we had to unpack the car and set up the tent and the beds and all that, and get supper and wash dishes, get up next morning and go through the same rigamarole in the other direction, and load up the car, and get started (there were no motels, nothing like that). The next night, we got to Ely, spent the

night in Ely, Nevada, and we stayed over in a hotel because we got in so late that night. We had supper and breakfast at the restaurant. And then we went out southeast of Ely and down through Spring Valley and up through Sacramento Pass and over into western Utah.

The road went a different route then than it does nowadays. We went north along the east side of the Snake range for, oh, maybe ten miles or more, and then of f to the east over what was known as Cowboy Summit and up through Margum Canyon in the House range. This House range is a fascinating place of early Cambrian marine sediments. (We collected some fossils there, by the way, some trilobites.) And it's called the House range because from a distance, the rocks are weathered in such a manner that they look like big houses.

And from there, we went to the east down into Delta, Utah, where we spent the night. We made a pretty good journey that time. Then, we went off to the east to get along the front of the Wasatch range and on north to Provo. I believe we camped out in Provo on the lawn at the county courthouse. I don't suppose they'd allow you to do that nowadays [laughing]. And then we camped out at a place south of Salt Lake City. I think the people's name was Nelson. And it rained and rained and rained. We spent several days there because I had to take the car to Salt Lake City to have it repaired. (We had one valve sticking, and this was only a four-cylinder car. And we got that fixed up.)

And then we went up the canyon, went up to Ogden and up the Weber River canyon and through Echo Canyon, and it was just mud. They were rebuilding the highway, and the mud was, oh, eighteen or twenty inches deep. And we plowed along through that and got out of it over into Wyoming. But the roads there were unpaved, too, and they were very slick. I almost went of f the grade a couple of times. And we couldn't travel very fast, nor did we want to. And we spent the night at—I forget the name of the town, the first town in Wyoming (oh, it was Evanston near the western edge of the state). The mud was about eight inches deep in the streets, and it sounded like batter—thick batter. When you drive through it, you hear "plop, plop." And the hotel room we had, the floor was a beautiful mosaic of burns from cigarette butts that had been thrown down on the linoleum. It gave it a very attractive pattern.

And the next day, we got to Rock Springs, where the big coal mines are, stayed over there. Then the next day at Laramie. We spent a little time in Laramie. And then down to Denver, and we camped out at Denver out at the racetrack and fairgrounds. And we spent a few days there and visited some of the surrounding country. And then we came back north to Cheyenne, in southeastern Wyoming, and spent the night at a hotel because it had been raining hard for several days. And then east through Nebraska, and the roads were rough, gravelly road, but it was muddy. We had no windshield wipers in those days, and so the windshield got so muddied up I had to put my head out of the window in order to see where to drive. And, of course, there was practically no traffic. When my face got so muddy I couldn't see any further, I'd stop and wash my face in a mud hole and go on again. I think we camped out that night at Grand Island. I don't know whether we stopped at Kearney or not. And then we went through Columbus and spent the night in Omaha. And they had a tornado there, we were on the edge of it, and people were up all night long, driving down tent stakes so their tents didn't blow over (ours stayed up quite well). The next night we spent at Spirit Lake, Iowa.

There were heavy winds that night, and the woman who ran the place was very much excited about these winds, and, of course, we, knowing no different, weren't worried at all. We were right on the edge of another tornado, and they are not very nice. Next morning, we got up into Minnesota (these roads were all paved). And we saw telephone lines and power lines and trees blown down all along the line.

We got into Minneapolis, and we camped at their big park down on the Mississippi River, just below St. Anthony's Falls, and observed an old abandoned river channel there, and also Minnehaha Falls, which were quite interesting. They keep them going now with an artesian well and a pump. Just imagine, we camped out there in that park for, oh, I guess a week or ten days 'til we finally found an apartment.

It was quite an experience for the children, too, because Faith drew maps of our trip coming that far east. Now, mind you, these little youngsters, seven, eight years old, and Faith drew maps of the trip, and Catherine went out and sold them to the other people in the park [laughing]-.-the only one of the Gianellas that was any good in salesmanship.

We had a tornado while we were at Minneapolis. I was studying French and German there in a summer course. I went over to the drugstore to get some paper, or something of that sort. And just as I went in the door, it was raining hard, and the thunder and lightning hadn't started yet. And just as I stepped in the door, there was a woman standing there, paralyzed with fright, I guess, and she said, "Do you think it's going to thunder and lightning?"

If I'd've known that she was scared of that sort of thing, I never would've. said .a. word like I did. But just as the storm opened, I said, "Young lady, in about two or three minutes, you're going to see the most terrific thunder and lightning you've ever experienced!" And just then, *wham*!

[Laughing] I had to grab this woman and lean her up against the counter. She was about to faint.Gee, I felt ashamed of myself. That lightning hit a transformer just about half a block away. So, really, it did do like I said I thought it might do.

And then, I got in the car and drove back to the apartment—only a few blocks. And it rained so hard that I couldn't see through the windshield at times and had to pull up to the curb and stop the car 'til it cleared up and then drive on a half block, and so forth. Fortunately, the traffic was not much. I drove the car into the garage and ran over to the apartment and watched out of the window and saw how the trees acted. And the wind was terrific! And actually, the tornado passed through the western part of Minneapolis about, oh, a mile and a half from us and tore the roof off the pavilion and cripped some people, tore of f the tops of trees and unroofed a few houses. It didn't get down and cut a swath. But just here and there, it would come down and take off a roof or so—bad enough. That's as close as I wanted to get, be to one of them, anyway.

And then [when] school was out, we went up to the famous Mesabi Iron Range, which lies up to the northwest of Minneapolis (some of the highest country in the state, about twenty-two or -three hundred feet elevation). And then we went up to the Vermillion Iron Range, north of Lake Superior, and around on an old road through some of the old abandoned lumber camps (of course, this was all unpaved road, rough road), and down westerly along the north shore of Lake Superior to Duluth. And so we got some groceries in Duluth, and went across and camped at Ashland, Wisconsin. And you run

through a short stretch of Wisconsin there, and then into Michigan. And we camped at Ashland, the place where they had the Apostle Isles, some islands out in Lake Superior, and we took a tour on a little boat out around these islands.

In coming back, we were sitting on the seat on the rear of the boat, and there was a man telling about his experiences in the West, and how wild and rough and woolly it was out there. (And, of course, we enjoyed this dissertation.) He told how the prospectors came into Reno and tied up their burros at the hitching posts (now, this was just, you know, about the time we left there), and they'd come in and take out their pokes full of gold dust, and the bartender'd take out a pinch for a drink, et cetera, and so forth. And he got into Cheyenne, Wyoming, and he was there during the cowboy celebration, and these cowboys would get fired up on firewater, and they would lay down on the pool tables and rake their spurs and claw up the broadcloth. And they got a great kick out of that, and so forth and so forth.

So finally, this fellow ran out of steam and calmed down, and somebody else turned around to me and said, "Where are you from?"

"Oh," I said, "I'm from Reno, Nevada."

And this fellow who was the famous storyteller [laughing] ducked down into the engine room and didn't show up for the rest of the trip. And at the docks we waited on the side of the street to watch him come out, and he ducked his head when he passed us, and went on. I hope he enjoyed himself.

Then we went on east on the south shore of Lake Superior and went up the Keweenaw Peninsula. The Keweenaw Peninsula, projecting northeast for fifty miles into Lake Superior, was a great copper-producing district when it was in its prime. And Michigan was the leading copper producer in the United States and remained so for a long, long period of time. And their copper was native copper. In other words, the copper occurred as copper, not combined with sulfides like our western copper deposits, and evidently was deposited that way largely in the tops of lava flows. They were full of holes, vesicles, as we call them. And they filled up with this native copper. And then it replaced the lava flows, too. Some sheets of copper run from one level to the other. They'd be a hundred feet long and maybe thirty, forty feet wide, and they had to cut them up with chisels and take them out in chunks, roll them—roll up this copper and drag it up the shaft by the hoist. Some copper also occurred in the conglomerates.

And we visited the Quincy Number Two shaft, which had the most modern hoisting equipment at that time. They had a compound steam engine that had high pressure steam on one side and low pressure on the other. It ran at a high rate of speed, hoisted from about seven thousand feet deep, on the incline, at about a forty-five-degree angle. And at the time we were there, of course, the production was not nearly what it used to be (this was in '25).

We went up to the north end of the peninsula and saw the big ships carry iron ore from Duluth to Ashland, Wisconsin. The ore coming down from the Mesabi Iron Range was loaded on the boats there, was just dumped into them. Then they sailed to the east end of Lake Superior and through the straits of Sault Ste. Marie—through the locks of Sault Ste. Marie, and down the rapids, and through Lake Huron and down past Port Huron, past Duluth, and on over to Lake Erie and to the smelters around Lake Erie; or some shipped from ports on the south shore of the lake to the coal mines south of there, where it was smelted. We got some nice blueberry

pie up there on Keweenaw Peninsula, as I remember.

And I found a pebble in the conglomerate at the northeast end of Keweenaw Peninsula. Now, interstratified with these pre-Cambrian lava flows, there are conglomerates. And most of these conglomerates were not basaltic like the lava flows. They were composed of a still older rock that was undergoing erosion at that time. And this older rock was a siliceous lava rock—I think probably the same rocks to the southwest that contain the copper ore deposits at White Pine, Michigan. So evidently, they had had an earlier deposition of copper before the lava flows and before the conglomerate was laid down because some of these pebbles had little particles of native copper in them that had been deposited there before they were rounded up by erosion. You could see where there was an indentation, where the erosion had pounded down the rock where the soft copper was. So the copper was in the pebbles while they were still a part of a large rock mass that had been mineralized. And this is not generally recognized. That pebble has been lost. I don't know whatever became of it. I brought it back to the School of Mines, and I could never find it in recent years. Somebody got away with it, or threw it away, or something. And it was well worth publishing on. A discussion of this copper occurrence would add to the knowledge of these famous deposits.

From the Michigan copper region we proceeded east through northern Michigan visiting some of the other iron mining districts on the way. We stayed over at Sault Ste. Marie, where we camped a few days. It was very interesting to watch the great iron ore-carrying boats passing through the locks there. Here we crossed over into Canada to see something of the country there. From Sault Ste. Marie, we drove south and crossed over the Straits of Mackinac on the ferry. There is a large bridge across the straits now.

We continued south through Michigan, passing through Sheboygan, where we had a broken spring repaired. All unpaved roads across northern Michigan and on this stretch, too. However, we reached paved roads before we arrived at Detroit. We continued through Toledo, Ohio, passed Sandusky, and on to Cleveland where we spent a day or so. Then northeastward, across a short stretch in Pennsylvania, and on to Niagara Falls, New York, where we remained for several days visiting places about Niagara Falls. We also camped one night on the Canadian side, where a better view of the Canadian falls is to be had. We went down to Dalhousie, where the Welland Ship Canal connects with Lake Ontario. It is by using this canal that ships can bypass Niagara Falls. We also saw the mouth of Niagara River where it empties into Lake Ontario. We visited St. Catherines and Hamilton and visited a few other towns.

We did some shopping over in Canada to get some nice English china. And from there, we went through the state of New York, stopping over at various places, Rochester, Schenectady, etc. We crossed southern Vermont, visiting Bennington and Brattleboro, then into New Hampshire and down the Hudson River Valley.

Then we got to New Haven, and we were allowed to camp on a man s lawn for pretty nearly a week until we found an apartment there. Imagine such things! Times have changed, and remarkably. Then I went to Yale for a year. And while there, I did field work as part of my graduate studies on the geology of the region around New Haven. And, of course, I took a great many trips out of New Haven, also.

And so I went to Yale one year, but I didn't like Yale too well, because, although they had

some professors that were very good, they had some that I didn't like very well. And so I decided to go to Columbia University in New York City the next year. So I went down and talked [it] over with the faculty and found that they were very agreeable and so I changed over. By the way, I went to Yale '25 to '26 and I started in at Columbia in the fall of '26. And in the meantime, the family and I took a trip down to the southern Appalachians.* So we got to see some of this country firsthand and met the southern people and had a very enjoyable summer.

So I went to Columbia that fall of 1926, and put in two years at Columbia and finally got my doctor's degree from Columbia. They asked me if I was coming back to Yale to get my degree several times, but I thought there was no need of switching back and forth like that. I enjoyed my work at Columbia quite well and had some very good instructors, Professor Berkey, particularly—Charles. P. Berkey—who was a very outstanding man and a very, very good teacher. And he always taught some elementary courses, despite the fact he was the chairman of the department and a man with a worldwide reputation. And Professor Johnson, who was an authority on land forms, shoreline development, and was a very stimulating teacher, also. And I took some courses in paleontology, although I wanted to specialize in ore deposits and petrography, which I did. I took this work in stratigraphy—that is, the study of sedimentary rocks and the various formations throughout the geological column, and particularly there in the eastern states. So, in that way, I got a great deal of study of the eastern geology. And then, I took a course in paleontology, "index fossils," as we called it. It was a study of the fossils that were considered, at that time, as indicators of the various geological systems like the Cambrian, Ordovician, Silurian, et cetera. And those fossils indicated the lower, middle, and upper portions of those systems of sediments, which I found quite interesting and very useful for me in my teaching afterward, although I didn't go in for paleontology or stratigraphy. But I always found it of considerable interest and help in later geological work.

I always like to collect fossils and send them in to paleontologists, or tell them where there were fossils they could collect, like fossil leaves. I collected with Professor [Daniel] Axelrod in several localities where there were fossil leaves, and also told him of others that he was interested in. And I made a collection of fossils on a trip to British Columbia, field trip, in '27. I shipped those fossils back to the University of Nevada.

A trip to Wyoming was a field trip that Professor Berkey and Professor [Samuel] Knight of the University of Wyoming led, and we spent, oh, something like a month looking over the stratigraphy of southern and central Wyoming. And we camped up on the Medicine Bow range of mountains, and at the end of the field season, we climbed Medicine Bow Peak, which is over 12,000 feet high. In fact, we just walked up the trail and walked up to the top of it. It was no jaunt at all, after spending the summer out there. When we first got there, however, we couldn't walk very well. We were camped at about 10,000 feet, and really, you couldn't walk more than two or three hundred feet without stopping to get your breath because the air was so thin, and we came up from sea level. But after rambling around at 6,500 and 7,000 feet for several weeks, then going from 10,000 up to 12,500 was very easy.

After that, we took a trip—after the field trip was over, we went down through Utah and to the north rim of the Grand Canyon of

*See below.

the Colorado, which was a very instructive and interesting trip, to see some of the Utah geology, and also to see the Grand Canyon, and oh, a lot of other places around there that were not only of geological interest, but where some of the early geology of the West had been done.

And it was there that I had a very interesting experience. One of the boys driving the cars, he was a student in geology at University of Wyoming, and a sort of a rough and ready type of person, and a real roughneck, so we thought. It just shows how you can't judge—well, you can judge people, but I mean, not accurately. There's a lot more to people than we usually realize. Somehow, [when] we have known a person for some little period of time, you sort of "pigeonhole" them as to their intelligence and their background and what they might do in the future, et cetera, and so forth. And, of course, you're usually way, way wrong because you can't judge people like that very accurately.

Well, anyway, these people were all talking and chattering and, how deep and how wide and how great, tall, and so forth, the Grand Canyon was, and the great colors and all that, and vying with each other to see if they couldn't exceed one another in flowery descriptions. And so I decided to go down where I could see more of it, and where it was a little quieter, and one could really enjoy the majesty of the Grand Canyon. It was really overwhelming, and—well, there were just no words to express your feelings, largely for lack of vocabulary, and also because a vocabulary doesn't cover a lot of these finer feelings. And much to my surprise, I came across this cowboy, way out there, sitting on a ledge. And I came up to him, I sat down. I didn't say anything, and finally, he spoke up. He said, "I came out here to get away from all that chatter." He said, "This thing is really too big to waste the time with a lot of idle chatter." And that struck me, too, as being, just to show this fellow had deeper feelings than a good many of those people that I judged were "above" him in background and training and so forth. Actually, under his rough exterior, he had much finer feelings than some of these college graduates that I thought—had every reason to believe—were far above this man, which they were not.

Oh, I should have mentioned, on my way up to Alaska after graduating from Oregon State, we stopped at the Taku Glacier, and that was the first time I'd ever seen a glacier. And it was—oh, I don't know how high—maybe five, six, seven, eight hundred feet, almost a vertical wall of ice coming out into the ocean. And big icebergs would break off and crash down into the ocean. And the ship came up within about a half-mile of it, I would judge—maybe three-quarters of a mile. And really, I was so taken up with this glacier that I didn't realize anybody was around me at all, and so much so, that when somebody spoke, I was startled. And, of course, that's when you really enjoy a sight like that, is when everything is quiet and you just don't let anything disturb you at all. And that's the way this cowboy felt down there in Arizona, I know.

Well, after we left there, we went back from the Grand Canyon, went up to Salt Lake City. And Professor [Patrick] Callaghan and I and one of the other boys treated the rest of the group to a dinner at a restaurant (I can't think of the name of it) in Salt Lake City. It was a very pleasant evening. And then the party broke up, and some went back to Wyoming, and the rest of the group went to New York, or wherever they were located.

I went out to Reno and got a car and traveled around to see some of the things around Reno that I was interested in, geological things. And then Professor Claude Jones and I went up to

Truckee with a—well, we met a man by the name of Close, Professor Hans Close, from Germany. He taught at Gottingen, I believe it was. Maybe I'm wrong on that. Anyway, he's a very noted German geologist and had done a lot of study of granitic intrusions and their effect on the surrounding rocks. And that's what he was interested [in] here out in the Sierras. A Professor Robert Balks of New York was with him; I had become somewhat acquainted with Balks at Columbia. So Professor Jones and I went up to the Truckee area and showed them what we knew about the geology around Donner Summit, where they have intrusive granites. And they invited me to go with them over to Grass Valley and Nevada City, which I told them I couldn't very well do. I didn't bring any money along with me and wasn't prepared for it. And Professor Balks just handed me twenty dollars and asked me if that would run me. And I told him, "Why it certainly would" [laughing]. Robert Balks was a very generous person. And I paid him back, of course, when I got back to Columbia that fall.

So then, I stayed overnight with them at Truckee, and the next day—of course in those days, there were few trucks and there were no regular buses running up and down Highway 40. So we took the train and went over to Cisco. And the train stopped at Cisco, so Balk and I got off, and the other two men, Close and his German student, went on to Emigrant Gap. They wanted to study some things around there and over north, on the South Yuba River.

So Professor Balks and I climbed Red Mountain. And on it, they have a lookout they call Signal Peak. That was a lookout where the Southern Pacific maintained a building and telephone connections and a lookout to watch the snowsheds in case of fire. At that time, they had about forty miles of snowsheds, and from there, you could see probably thirty miles of them. And this man could spot fires a long time before they'd be discovered otherwise. And then he'd telephone down and he'd tell the fire crew where the fire was, and then they would get in there and put them out. And, of course, there's no need of that now because most snowsheds are torn down. They probably have ten miles or less now because they have better snow removing equipment with these big rotary plows. And also, the snowsheds that are left are being replaced now by concrete structures, so there's no danger of fire in them.

Then Balks and I came down off Red Mountain. (I've often wanted to go back up there again, but I don't have the energy I had back in those days. I might go up there again anyway. I enjoyed the view from there. And forty some-odd years later, I supposed I could make it again by taking it easy.) Well, anyway, we came back to the highway, and, of course, there'd be no more trains that night and no buses and no traffic on the road to speak of—occasional truck and that was all. So we walked from there over to Emigrant Gap station, and most everything was shut up, of course. We got in there about ten o'clock at night. So we went over to the grocery store and rousted them out and got some cold canned goods to eat for our supper. I went to bed, and Balks sat up and waited for Professor Close and his student to get back.

From what I could make out from what they said, they had walked around the old flume that takes off of the south fork of the Yuba River, just before it enters a steep canyon. This flume (now gone) used to carry water to the hydraulic mine at Omega. They went around to the old hydraulic mine at Omega. (They had hydraulic gold mines up there; one was Alpha, and one was Omega, and this Omega was the easternmost one.) And they

walked down from there to the Eagle Bird mine. They thought that was a funny name, Eagle Bird. (Well, I think it's rather unusual, to say the least.) And then they came back up and walked back along this flume, and they tried to catch some animal in the flume that I told them they were very fortunate they did not because I figured out from their description it must have been a skunk. And, [laughing] you know, they don't have skunks in Europe. The skunks are a typical American animals, and this one that we have around here's a typical western, Pacific coast skunk. I don't think it lives in the eastern states. Anyway, they were fortunate not to catch the skunk.

Then the next morning, we got up early and took the train to Colfax. They were very much impressed with the big mountain steam engines the Southern Pacific had at that time, hauling freight over the mountain. The diesels came in many years later. We went to Colfax, got off at Colfax, and caught the little narrow gauge train that went to Grass Valley and Nevada City. And Professor Balks and Close were discussing—in German, of course, because that was their native language—the geology going over, and what little I knew of German, I finally got only what was amusing them was the fact that [in] this country, there were very few rock exposures. If you've gone over that route, you will recall that there are few rock exposures. It's well timbered, and there's deep weathering of the rocks, and it's a smooth country, or gently rolling country. Actually, it's an old erosion surface. It's the remnant of a long period of erosion that brought the country down to practically level. And it has been isolated and not destroyed by later erosion that's going on at the present time. So I told then that when they got to Grass Valley, we'd go out on the observation platform, and when we passed over the divide going down to Nevada City, that they would see a very youthful topography, one that's undergoing rapid erosion. And they could hardly believe that there'd be such a change in just a few miles. So they were very enthused at seeing this. There were plenty of rock outcrops.

So after dinner, I got them to walk down with me down Deer Creek, which flows through Nevada City (Wolf Creek flows through Grass Valley), and had them walk down to the mine down in the canyon. I think it's called the Champion. Anyway, there's a big dump of practically pure quartz. Evidently there were some big quartz veins in that mine that had very little gold in them. However, it was a very productive gold mine. And it was just about sundown, or a little after sundown. And naturally, you get out on a big dump of rock like that, you tend to roll boulders down to see what they'll do. Oldsters as well as youngsters do those things. And they flashed fire—no, not fire, but light. It's very common with quartz, although a great many geologists and mineralogists do not know that. But they gave of f light, because, rubbing together, they generate light, and that light is due to frictional effects upon the molecules, so I've been told. And it gives off light. It's a cold light. And it'll be given off under water as well as out in the air.

Well, the next morning, we went on north from there on Highway 49, and Professor Close and I got off. He wanted to see something about the South Fork of the Yuba River, and Balks and the German student went over to the Middle Fork of the Yuba, where they were to examine some granite rock that evidently was sheared while it was intruding and developed into what is known as a gneiss (a gneiss, which is a banded rock, a German word). And while they were there, Close and I went down below the bridge and walked down the south fork of the Yuba.

Well, I had been telling him things that we expected to see when we got over there. And so when he got there, we went down on the bridge and saw this big rock [which] weighed about, oh, I would judge, thirty or forty tons. And in that granite boulder, there were inclusions of country rock that had been picked up by the molten granite. And these included rocks were sheared and caused a fracture along the center of the inclusion and diagonal fractures at an angle of about forty degrees to that center fracture. Then these were in turn filled with minerals that had been introduced, epidote and possibly hornblende. And so, Professor Close was very much interested in that. And he asked me when I was through there last, and I told him, oh, about four, five years ago. And he wanted to know how many times I'd been through there, and I said just twice. So he thought I had pretty good powers of observation to see all these things and to remember them. I've always had a pretty good memory for that sort of thing.

so then we walked down the canyon from there and found potholes, in which we were both very much interested. And we found we could make these boulders in the potholes roll around by just throwing a little sand in while the water was running over them, or stir them up with a stick and they'd grind around for several minutes before they'd settle down. And we reached down in these potholes (some were about arm length), and you could pick up these boulders, and they were perfectly round. They were about as big as a croquet ball (about three or four inches in diameter). And those rolling around and around was what caused those potholes to wear down into the surrounding rock.

Well, I was down there a year or so ago, and I can't find those potholes. They're evidently all covered with a gravel bar. And this big boulder that weighed thirty or forty tons was washed out from under the bridge by floods we had in the early '50's and carried downstream (I don't know where; it's gone out of sight, anyway). And that's interesting because those canyons, twenty or thirty years ago, they were filled up with sand and tailings from the hydraulic mines from the Omega and Alpha mines and also those at Relief Hill, and also at North Bloomfield, where they dumped all of their tailings, millions of tons, down into the south fork of the Yuba. But now, bedrock is exposed, and most of all that sand and gravels are washed out of those canyons.

And I know of a good many places where thirty, forty feet of tailings have been removed in the past thirty, forty years. I remember particularly over at Dutch Flat, where there were big hydraulic mines, and also the big hydraulic mines at Red Dog and You Bet, dumped tailings into the Bear River. Not only Dutch Flat, but across the river from Dutch Flat, at the Little York and other mines, they dumped their tailings into the Bear River. And in the flood of '52, the bridge that goes on that road going from Dutch Flat to Red Dog and You Bet washed out. And I went down there with Larry Beal a few years ago, and we found that a lower bridge that was exposed, or the abutments to it—evidently from way, way back in the early days, it was exposed by the gravels being washed out. And also, there were stumps of trees, and these stumps were eight or ten feet high. And they were evidently trees that were growing there during hydraulic mining, and they were killed by being buried by the gravels. And now they are exposed. So I know that that canyon has been —the gravel has been—eroded out of it to a depth of twenty-five or thirty feet since I first saw it. I know of other canyons that've had gravel carried out to a depth of thirty or forty, fifty feet.

Anyway, we had a very fine trip with Close and Balk, and I left them at Colfax and went back to Reno and finally went on east on the Canadian Pacific Railroad, went up to British Columbia. Oh, I collected some fossils, too, on the way back, up near Kicking Horse Pass, which got its name from Fraser. (A Canadian explorer who came out through that country, and coming over the divide, one of the horses kicked him and crippled him up for quite a while, and they named this pass Kicking Horse Pass after that incident.) Fraser River was also named after this man Fraser. He was exploring for the Hudson Bay Company. Well, I stopped off at a little place called Field.

I got off at Field [British Columbia], and stayed overnight at the hotel. And early next morning, I got a lunch put up and started up a mountain off to the south because I wanted to collect some fossils from that area because the fossils were noted because they were middle Cambrian fossils, probably 400,000,000 years or so old. And they had preserved sea worms and other delicate structures as the fringes on the legs of trilobites, and the internal organs of some of these animals had been preserved, one of the few places in the world where these delicate parts were so well preserved. So I wanted to make a collection of those, which I did. And the hotel where I stayed over, I asked the man about where the trail was and how we got up there and how long it took to go up there, and he looked me up and down and decided that I wasn't very robust, and, "Well," he said, "the people around here that are used to going up that trail, they go up to this place and back in about a couple of hours." He says, "I guess you could do it in four hours, but you'll be late for your train. It leaves this evening."

And I said, "Well, I'll make a try at it, anyway." And after hiking around Wyoming and Nevada all summer long, I was in very good condition. As a matter of fact, I walked up there in about a half an hour, and I spent an hour and a half or two hours gathering up fossils 'til I had all I could possibly carry. I came back down to the railroad depot—ex—press depot—went over to the hardware store and got a big wooden box, wrapped them all up, packed them very securely and named them, and shipped them back to the School of Mines at Reno, and then had time to clean up and eat a hearty meal and catch my train out that evening. And this man was very much surprised to see me come in [laughing] with a back load of fossils.

And then I went on through to Montreal and met the family. They came up from New York City to meet me. And we had an enjoyable stay over, and then we went on back in time for the starting of school that tall.

While I was at Columbia, we took field trips over to Franklin Furnace, New Jersey to the famous zinc mines. And we also had a field trip to the Adirondack Mountains where we had a chance to study the geological column, which is what they called the "standard geological column" from the eastern United States. And Professor Berkey conducted that field trip.

Now, I might say something more about our trip to the southern Appalachians. I skipped over that. We visited Harper's Ferry and we were in the—oh, what's the name of that valley where Sherman made his famous ride? The Shenandoah Valley. Winchester. And we visited Chattanooga and visited the battlefield at Chicamauga and Atlanta, Peach Tree Street, and we visited many places where Sherman's army marched through that area and visited those battlefields. The one out of Chattanooga was called Chicamauga, one of them, and the other was, I believe, Cemetery Ridge, and Lookout Mountain, near Chattanooga, the big battle was there.

And coming back, we stopped at Gettysburg, where they had a Seminary Ridge, where a lot of the battle was fought. And we got to see the critical points there where Pickett's last charge was made, also Little Round Top, where—oh, a man who came out to the West here in the Mexican War, came out with Kearny. He surveyed the boundary between Mexico and the United States, also. But he was in the Union Army; he was a major at that time. And he saw the value of Little Round Top and took it, which kept the Confederate Army from turning the left wing of the Union Army. And while south, I visited the pegmatite areas around Nashville (it's beautiful country around Nashville). They were being mined for feldspar and mica. And these pegmatites had a great many uranium minerals. So I collected quite a few of these uranium minerals, also collected some fossils down in that territory. These are in the Mackay museum.

And then in 1928, we returned to Nevada, and we came around through the Panama Canal to Los Angeles and then drove our car from there back to Reno.

4

A Career at the University of Nevada, 1923-1952

A Note on Teaching Methods in Geology

Well, now about teaching: of course, I had good preparation for teaching with my outside experience plus graduate work at Columbia, which proved invaluable. So I taught mineralogy and petrography and economy geology of the metals when I came back. I enjoyed teaching very much. It took a lot of energy, too, to teach right and —well, what I thought was the right way to teach. And I put in a lot of excess time with my students, much more than is usually done. But I thought it was well worth it. I will tell you something of them later. But first I will tell about teaching and other professional activities.

Now, you mentioned something about telling about teaching methods. I had no formal training in teaching; few college professors do. What happens is that, in geology and mineralogy—in fact, in most of the sciences—we have a large choice of good textbooks. So in most of my courses, I had texts that the student's supposed to own, and I gave them assignments from the text. And I also largely followed the text in my lectures, and at times, bringing in my personal experiences or that of modern workers in the field doing current work. Because in general geology, you'll find the textbooks often are slanted more or less to the region in which the author is best acquainted (that's perfectly natural, you know).

When I went to college and took general geology, my professor referred to nothing in the immediate neighborhood so that I had no opportunity at all of correlating much that was mentioned in the textbook with anything that I could see around the area. And it always seemed to me that geology only applied to far, distant places because the textbook mentioned nothing locally, although—. Now, that was up in Oregon.

I could see, myself, although I'd had no experience in geology, that there were some things in the Willamette Valley that were very unusual and strange in that there were large granite boulders—large and small—up and down the valley, and they were deposited

upon quite young—or much younger—basalt flows than the granite. And being there's no granite outcrops in the area, it showed that they were brought from a long, long distance. There were also large fragments of metamorphic rock, some of which weighed many, many tons. It has been determined later that they were brought down the Columbia River from eastern Oregon, probably with this great flood. I think I mentioned before about the overflow of Lake Bonneville, of which we knew nothing, of course, in those days. And as that occurred during glacial times, it is quite probable that a great many of these boulders were ice rafted. And that's what accounts for them coming way up the Willamette Valley. And, of course, that big flood was too great to get out of the gorge between Portland and the coast and backed water up the Willamette Valley, and that gorge also may have been clogged up with detritus, ice, brush, trees, rocks, and so forth, during the time of the flood. Some of these boulders are, oh, a hundred, a hundred and fifty feet or more above sea level. So they must've had deep water in the Willamette Valley at that time.

For that reason, when I taught, I tried to make the subject more lively and more interesting by showing how geology applied to Nevada and eastern California, and particularly about many areas practically within sight of the University that students could see for themselves, because we have some outstanding geological features right there within sight of the campus, which I thought was of value to acquaint the students. So I hope none of them went away thinking that geology only applied to the Appalachians or the Swiss Alps or something of that sort, or the Sahara Desert. (Of course, our desert's nothing like the Sahara. What we call a desert they'd call a land of milk and honey.)

Well, I think our geology students were pretty well satisfied with their work and were interested in their work. They probably didn't find their work boring. A good many institutions—of course, nowadays, it's different; they seem to be all bored. But in those days, I think we were able to keep the work interesting so that the students wouldn't get bored. It's an awful crime or shame when students want to come to an institution, and then, because of being disappointed in the work that's being given, or not being what they expected it to be, or that their teachers were not interesting (not to say inspiring), of course, that ofttimes kills the student's enthusiasm. But a teacher should try to be at least interesting, and if possible, inspiring to the students, give the students something to look forward to. Because they'll learn much more from a teacher like that than they will a teacher who's not interesting.

Some teachers are absolutely boring. I'll never forget one time I took a course in steam engines and boilers. And to me, it was a very monotonous subject, and the teacher had a droning voice [dragging out his words as though they were an effort to articulate]. And this class came at one-fifteen in the afternoon on warm days, and we were just filled up on dinner and were drowsy anyway. And he'd drone along up there at the desk, and the bees outside in the honeysuckle growing over the windows, they were droning also. And [it was] all we could do to keep awake. Some of that, of course, wasn't his fault. But he could've at least dropped an eraser or something to kind of break the monotony. (That's a handy thing, you know, drop a rock on the floor or something. I used to wake my students up that way at one o'clock class—drop a rock, or drop a big book, or something or other. Rocks are better dropped than books because it hurts the book; it doesn't bother the rocks any.)

Let's see. Now then, I used to enjoy getting out in the field with my students, too, out

on trips. And I used to give short trips on Saturdays quite frequently, an allday trip. That way, I got to learn the students better, and they got to know me better. And I think we got to be better friends, rather than just teacher and student.

[Laughing] I remember once I went out on one of these Saturday trips with Professor Jones. And we went up to Verdi to look at some things, and went up to the slope toward Peavine, you know, opposite the old steel bridge up there. And there was a huge granite rock lying alongside of a fence about a mile or a mile and a half from the river. And the underlying rock was all lakebeds or young—geologically young—Tertiary lava flows. And this granite boulder was out of place, naturally, and been there a long, long time and was buried in the earth—I don't know how deep—I should judge a couple of feet at least. And it was about six feet wide and, oh, ten, twelve feet long, stood about two feet above the surface, so it would, oh, contain about a hundred and twenty cubic feet of rock, which would be a good many tons—I imagine ten, fifteen tons—alongside of this wire fence.

So Professor Jones asked the students how that rock got there. (Well, at that time, I wasn't in his class. I was doing graduate work, and Jones didn't mind a gag once in a while, anyway.) So nobody could guess how the rock got there. And, "Well," I said, "I have a suggestion." I said, It looks to me like you can see it has a lot of Indian mortar holes in it, ten or fifteen. And that granite boulder doesn't belong way out up here. It should be down on the river some place. And the only way I can figure it got up here was that when those Indians moved, they started taking this grinding stone with them. And when the young bucks got up here at this fence, they set the stone down to rest before they put it over the fence and just forgot to come back after it."

Jones screwed his face up and didn't say anything, turned away and looked off into the distance. And some of the fellows chuckled, and we went on about our business. And, of course, what Professor Jones had in mind was, it was probably brought up there by the glaciers. Either—it had to be so—it wasn't a flood because there'd be a lot of boulders all around, and the only thing that'd leave an isolated boulder like that would probably be the glacier, and a big boulder like that. I don't think we have floods now that would move boulders like that. But we did have in times past.

And the funny part of it was, that afterward—I didn't think it was too good a joke myself, until later. And one of the students, one of these fellows that fired up mentally very slowly—he seldom missed a joke, but it probably took him a week or so to get the punchline—so he came to me about a week later, and he said, "You thought you were putting something over on us out there last Saturday, didn't you?"

I said, "In what way?"

"Well," he said, "about those Indians setting that rock down by that fence."

"Oh," I said, "Of course, that was naturally a gag."

He said, "Of course it was. That fence wasn't there at that time" [laughing]. So he still didn't [laughing]— he *still* didn't get the point. "*There wasn't any fence there at that time*," which was a perfectly valid observation.

And we took our classes out to Steamboat. And they were able to read about Steamboat, articles written by famous men, such as George F. Becker, Waldemar Lindgren, and others, and then see for themselves what was going on there. And then at the Comstock, they'd go underground, and these mines were quite hot. While I was teaching, there was only two or three shafts open. There was the Union

shaft in Virginia City, and the Overman shaft at Gold Hill. [Laughing] It's down in the gulch in Gold Hill, right next to the Yellow Jacket. That shaft was open and operating. And you could go down that to the, I think 1,100-foot level.

So I used to take my students down to show them that sort of thing. One day, we had two girls that insisted on going up there. They wanted to take this trip with us and go underground. So we went down the Overman shaft at Gold Hill. Or maybe we went down the Union shaft—I don't know— and made that long walk of a mile or so to get over here to the mines that were operating in Gold Hill. No, there was no connection through there. We must've gone down the shaft in Silver City. I had a long talk with the foreman before we got the girls underground because the miners have a superstition about women going underground. They're bound, they thought, to have terrible disasters afterward. Well, the disasters weren't so bad. But in order to educate these girls, I took the group up into the hottest place I could find in that mine. And we all sat down and I gave them a long lecture on ore deposition and minerals and the good of the country and all those sort of things, you know, that might occupy a lengthy lecture. So their hair became uncurled and stringy and hung down over their ears (they wore long [curly] hair in those days; the boys wore short hair). And their hair became wet and stringy and their clothes became saturated with moisture, and they looked like they— well, you know how they used to dunk chickens in scalding water to pick the feathers of f of them? They looked like a dunked chicken. That'd be just how you explain it. So that wasn't a very popular trip with the girls, after that.

But having an operating mine like that, and one that was very hot, and had had hotter places, and one that pumped a tremendous amount of hot water, a mine that had a great economic as well as romantic history back of it, and where so many things had been invented, like huge Cornish pumps (now, the Cornish pump came from Cornwall, of course. But on the Comstock, they had big and better ones.) They had great hoist engines that were made specially for the Comstock.

Sketches of Some Nevada Faculty Members

Now, about some of the faculty members. I felt that at the time I took my graduate work, and later, when I was teaching at the University, that, in general, the University had a well-qualified staff and with quite a few outstanding men. I mentioned a few. And, of course, they have just as good a staff now and better qualified, for that matter, considering the time and place. However, this geological staff is getting so large now that no one person is able to know intimately but very, very few of the staff. And, of course, conditions now are much different than they were then, anyway.

Of course, anybody writing up, say, the history of the University or of [any] department is bound to leave out certain features with which they probably could not be informed on, or would seem to them a minor point, if they did think of it, whereas to some other part or department of the University, that may be a major factor. There're two that I wish to mention in particular.

One is that Professor George D. Louderback taught at the University of Nevada for, I think, one year. He came up to the University investigating at one time, several years later than that, on the possibility of his being appointed president of the University of Nevada, which he evidently didn't care for after he'd looked things over. And I knew Professor

Louderback in later years very well— I mean, along in the '20's and '30's, '40's—and I liked him very much.

I'll tell something more about Professor George D. Louderback. He became professor of geology at the University of Nevada Mackay School of Mines in 1903. It wasn't the Mackay School of Mines then. It was called the Nevada School of Mines, and it didn't become Mackay School of Mines until 1908, I believe. Anyway, Professor Louderback became professor of geology in 1903, and he had an assistant [by the] name of John A. Reid, as assistant professor of geology and mining. Professor Louderback established the department of geology. Before that, it was simply in the mining department and a professor of geology in the mining department. So he established the geology department. He taught there a year or so and went back to Berkeley as professor of geology at the University of California, where he taught for many, many years and became chairman of the department. He was an outstanding geologist of nationwide fame.

And he has further connection with Nevada in that while at the University of Nevada, or shortly thereafter, he wrote two of the very early papers on the geology of that area. One had to do with the geology of the eastern Sierra Nevada and adjacent Nevada region, which became a classic paper and frequently referred to. And [he wrote] another one on the geological section from Lovelock, Nevada, eastward to the Stillwater range. Among other things, he described the tilted Stillwater range capped with the lava flow on top of it. And later on, that type of mountain was designated in geologic literature as a "Louderback." That's a tilted mountain covered with a layer of lava on summit. Well, that's gotten into the literature.

Also, Professor Louderback did a great deal of work on Basin Range structure, particularly of the western Great Basin and the eastern front of the Sierra Nevada. He published quite a few excellent papers in connection with that work. I knew him quite well and met him at the Comstock several times.

And by the way, ten or fifteen years ago, we named a group of mountains after Professor Louderback, the Louderback Mountains, which are over just west of the Wonder mining district, between that and Dixie Valley, small group of mountains in which there was a strong earthquake about 1903. And some of the faults formed at that time were also moved, or reopened (had recurrent movement on them) during the big earthquake of 1954. And it was while several geologists were working on that that they gave the name "Louderback Mountains" to the range in which those older earthquake faults occur. Those are the first known faults producing earthquakes in historical times that are mapped in Nevada and the first ones we have any record of.

Another man I must mention in that connection is John A. Reid, who taught at the University for several years. (Professor Palmer could tell you more about him, Professor Walter Palmer, because he took classes from Dr. John Reid.) And he used to conduct field trips. Now, the following sounds funny nowadays. They took the Virginia and Truckee railroad out of Reno early in the morning, about seven-thirty, and they'd ride out, say to Lakeview Summit. The class would get off there. They'd hike up into the mountains toward Little Valley. And during this time, Reid was mapping the country and teaching the students geology. And then they would come down at night, about five o'clock in the evening, to some place where the railroad stopped and ride back into Reno. Now, imagine, nowadays! It's inconceivable. They had no automobiles in those days, and

you couldn't do that sort of work by horse and buggy, or horseback, not with headquarters in Reno. You'd have to go out there and camp in the hills otherwise.

Well, Reid made quite an impression on the department and on the geology of Nevada because he wrote his doctor's dissertation on the geology of the Lake Tahoe region and areas to the northeast of Lake Tahoe, as at Marlette Lake, around Little Valley and Washoe Valley and Carson City, and across into the Pine Nut Mountains, and also somewhat in the Virginia Range. Now this was a pioneering work, the first to cover this region, and it was published as his doctor's dissertation at University of California. It's called "The Geomorphogeny (which is an odd word) of the Sierra Nevada Northeast of Lake Tahoe." Unfortunately, he died of tuberculosis shortly before his paper came out; he died about 1909. And he also brought to the attention of geologists the old Tertiary, gold-bearing, river channel that extends from the high peak north of Marlette Lake—not Marlette Peak, but an unnamed peak, the top of which, by the way, is composed entirely of river gravels, the highest peak within miles. And he traced and mapped the channel down across into Washoe Valley. And later on, about 1908, he wrote an article—quite an extended article—for the *Mining and Scientific Press*, giving a more detailed map of this river and a detailed discussion of it.

In later years, I had an opportunity of finding parts of the old river channel on the southeast corner of Washoe Lake, and it also contained gold there. I panned some gold out of it, and followed it up, in patches here and there, into the Washoe Mountains to the east and found a small part of it over about three miles southwest of Silver City. And therefore, I was able to determine that it flowed eastward, as Reid thought it had, because I found some limestone boulders. And I found a piece of rock—a very unusual rock—of a felsitic lava rock that had been fractured and cemented together with tourmaline and a carbonate mineral—probably calcite or other carbonate. And you can find outcrops of those, the limestone and odd volcanic rock, about a mile to the west of where I found them in the river channel, showing that the river flowed eastward. I was unable to find a trace of it beyond there. But that is a landmark in geology because Professor Reid has drawn the attention of geologists to the existence of this old gold-bearing river channel, which otherwise probably would not [have] gotten into literature until a much later date. Not many appear to know of it even now. It is an important geologic feature.

And he also told about the early placer mining on that channel in Little Valley, and also, in the hills southwest of southern Washoe Valley. And furthermore, a family by the name of Lewers lived out in Washoe Valley. Miss Kate Lewers taught at the University for some time, and her brother was vice president (I don't just recall the dates). And she had a brother who was killed by a cave-in in a tunnel that he was driving into these gravels, in the hills southwest of Washoe Valley, or south of Washoe Valley. So you see, the University [was] indirectly connected with that development, and it was Reid's work that got this river channel really into the literature of geology.

Reid was a very prolific and interesting writer, too, in the short time that he lived after doing his undergraduate work and graduate work at the University of California. He published those two papers, his thesis, and the one on the Tertiary river gravel near Carson City, and another paper on the foothill copper deposits of California (which is very frequently referred to), and many other papers. Also, one on the structure of the Comstock Lode, where he did considerable investigation.

So John Reid should be mentioned as one of the professors of the University of Nevada because of his work; he was so active for the short time he was there. If I had been that active, and [had that] much time available, why, I'd've had books filled with articles.

Now, at a later time, two women came up to the University of Nevada (this must've been along in the late '30's or middle '30's), and they wanted to look for a copper, gold copper, mine that had been discovered on the Hobart (they were related to the Hobarts) estate back in the early 1900's. There's a man in Carson City that worked on the V and T railroad, and he used to go up into the Carson range and bring down large amounts of this native copper, which ran about, I think seven- or eight-tenths of an ounce of gold to the ton of copper. His name was Barkley. Some of his descendants are still living—or relatives still living—in Reno and Sparks (I knew some of them). And he brought down a great amount of this ore. I've seen some of it, probably a hundred pounds of it; it's practically all gone now, as far as I know. And he had found it somewhere up in the mountains in the vicinity of Marlette Lake. A great many people have looked for it and were unable to find it, and these women came up and they wanted to find it. And I told them that I didn't see how they possibly could—well, they might find it, but it'd be a very, very tedious and difficult thing. I think it could be found, but one should need to have a knowledge of geology and have a lot of physical endurance to tramp over that rugged country in order to find it. I thought I would look for it sometime myself but never got around to it. Probably just as well. I'd've got plenty of exercise but probably found no copper.

So I told them, I said, "Well, a thing that you might find more interesting up there on the Hobart estate is an old gold-bearing river channel that was described by Professor Reid." So I got out a copy of Reid's publication, and with that, they went up there and did some placer mining up there. Oh, they did a lot of hard work and got blisters and calluses on their hands, and they collected quite a little gold, and built a small house, used on vacations, that was still up there in the woods the last time I was through there. I don't know how much gold they got. They never told me, and I never asked them. But they must've got quite a lot of fun out of it because they spent summer after summer [there]. They made it a regular summer vacation time going up there, mining gold.

Then later, another one of the relatives decided to mine the gold and drove a tunnel. And I did some consulting work on that tunnel. And one good thing that this work was done: although they never did any mining, never reached the river channel—went at it in the wrong way—but we did find that there were east-west faults slicing through the mountains there, and were faults of considerable throw, which is of interest because east-west faults cutting through the Sierra Nevada are very uncommon. These are covered with loose material and not visible at the surface.

And Professor Reid, as I told you before, was a very active man. He used to take the students out on field trips. Professor [Walter] Palmer told me about some of those trips. I believe he had a photograph of one where he and other students in 1904 or '05 were out at Steamboat Springs with Professor [Reid] out on a field trip. And while teaching these students field methods and field geology, Reid at the same time was mapping this area; later he published this map in his thesis.

So, you see, between Professor Louderback and Professor Reid and their publications and this old river channel, that people that were connected with the University and some of

their folks were connected with that mining out there, and so forth, ties in very nicely with the history of the University as well as the geology department.

I became chairman of the department about '35, I believe it was. At that time, Professor Harry E. Wheeler joined the geology department, and he has become quite a prominent geologist, particularly in stratigraphy. He's done a great deal of publishing on geological features, particularly of western North America. He resigned in '49 to become professor of geology at University of Washington, where he is still teaching.

And then, another one of our noted men of the department was Professor Allan Cree, who joined the department in '46. He was a specialist in oil geology. He taught our students a good deal about petroleum geology. He's a very good teacher, and the students liked him very well. He also resigned in '49, and he went to work for the Cities Service Company, which is an oil and gas producing company, among other things. And he rose quickly to a very high position with the company. I believe he was in charge of their foreign operations with an office in New York City. I've met him several times since, and he's been very, very successful.

Professor E. Richard Larson joined the geological faculty in the fall of 1949. He became chairman in '52. He has been very successful in teaching. He's done excellent research in geology, particularly in geological mapping in Nevada and adjacent parts of California. Still teaching at the University.

And then we had, oh, quite a few instructors that came on to the staff and were there for a year or so and left for various reasons, some because they were dissatisfied, some because we thought we could do better by getting some others, instructors. We tried to build up the departments the best we could by getting good men to take over.

I don't want to miss our professor of mathematics when I was there, Charlie Haseman. Charlie Haseman was an outstanding mathematician and a very good teacher, rather an irascible man in his classes, though. At times, he'd throw chalk and erasers at various students. But he was a highly qualified man, took a great deal of interest in the glee club and the band and various activities on the campus. I had no work with Haseman. I simply knew him as a faculty member.

In 1934, Thomas P. Thayer came to the University and taught for a year or two and then went into the Geological Survey. He's become a very successful man, done a great deal of work on petrology, the study of rocks, and particularly on chrome deposits, and has become quite an authority on chrome deposits and other lines of investigation for the Geological Survey.

Now, I want to tell something about Cruz Venstrom and George Hardman's work on tree rings. They did their excellent research in the late '20's and early 1930's on the history of the rise and fall of Winnemucca and Pyramid Lakes through the interpretation of climate as shown by the annual ring growth of the yellow pine trees, *Pinus ponderosa*. They found one over 850 years old and many over 500 years old. The [study of] ring growth was discovered and worked on by Professor Douglass [who] I told you about before, Professor Douglass of the University of Arizona. In 1931, when the water in Lake Tahoe was very low after a period of dry years —(and I want to tell you now that Lake Tahoe didn't overflow its rim in the fall of 1889. I knew a man that used to be there. I can't think of his name now. We called him "Swede," and he worked for the hardware store down on the corner of Sierra and Commercial Row, Reno Mercantile. He worked there. And he told me that he drove a wagon—a team and a wagon— across the

outlet of Lake Tahoe in the fall of 1889, and it had been dry for some time then. Then that winter, they had a very heavy rainfall and snow and blocked the trains passing through the Sierra. That seems to happen at times. After very dry years, they get exceptionally wet ones, or vice versa. After the heavy storms of 1861 and '2, they had an extreme drought in '64 or '65, when they had no rain to mention for a whole year.)

I want to get back now to Venstrom and Hardman. I made these drillings. In 1931, I took core samples on stumps at the south end of Lake Tahoe, near Tallac, at the old Baldwin resort, long since abandoned. These stumps are under water during years of normal precipitation. And we also got borings on trees three hundred, four hundred years old, standing on the bank nearby for comparison. And from the borings I made, which consisted of only about a half stump or less because the outer part had rotted away, and I could only obtain cores from about a third of the whole tree—and this showed a period of about 175 years. This period must have been a long, long time ago because it wouldn't match trees growing nearby. And it might be representative of the drought that happened here seven hundred or eight hundred years ago, and the age of those tree stumps should really be determined by modern methods, by carbon 14.

Some Presidents of the University

Now, as far as University presidents are concerned, President [Walter E.] Clark, who was president when I came to the University, was quite an outstanding man. He had a fine record of a good many years' teaching in New York City before he came to the University. He was well versed in economics, and he made that a specialty. And the University grew quite a bit while Dr. Clark was there. It got up to about 900 to 1,100 students and stayed that way until comparatively recent years. Actually, it was after I was retired before it started growing in leaps and bounds.

Then, we had Professor [Leon] Hartman as a president for a few years. Professor Hartman was an excellent teacher of physics, a highly skilled, trained man, a very good teacher, a very exacting teacher. And the engineers certainly appreciated that in after life, that they had such a good foundation in physics.

President [John O.] Moseley was there but a few years. I can't say much about Moseley's administration. Nothing unusual happened. And then, Colonel [Gilbert E.] Parker took over for a year. Then Malcolm Love was president. I thought Malcolm Love was a very, very good president, got along well with the faculty members and the students. But for some reason—oh, along about that time, there was something wrong about the administration. Everybody seemed to be on pins and needles and it didn't seem like any man could or would stay there for very long. Love left Nevada after a couple of years and went down to San Diego State College. He's been president of that institution ever since and seems to've done remarkably well there, and I think he probably would've done well if he'd stayed on at Nevada. Then [Minard] Stout was there for a few years. I retired about the time Stout was there. I knew nothing about President [Charles J.] Armstrong; I had met him, but in passing.

President [N. Edd] Miller strikes me as an outstanding man. He's done a very good job with the students as well as faculty, and so far has avoided any of these horrible "confrontations," as they're calling them, that are occurring all over the country among colleges, with all this disturbance and

mindless destruction of property for no known reason that I can see. These students probably have good reasons for not liking conditions as they are now, but I think a lot of the rest of us don't like them either. The older people don't seem to think that the best way to cure things is to tear up and destroy everything that you have now. We feel that changes are due and should come, but not at the expense of destroying what we have now.

What was the relationship of these presidents with the School of Mines, as I observed it? Hartman was rather slanted against the School of Mines because I know he told me at one time, personally, that he thought the School of Mines staff were overpaid. Just think, they were getting $4,250 a year, whereas the professors in other departments were getting thirty-eight or -nine hundred. President Clark always thought that the endowment that Clarence Mackay made to the School of Mines had kept their salaries at a higher point was a good thing for the University to hold to, as a target toward which to increase the other salaries. Well, Professor Hartman took the opposite standpoint. He thought nobody should be paid any more than anybody else, and bring them all down to a uniform level where we stayed for a long, long time. It wasn't 'til along in the middle '50's that the scale of pay of the Nevada staff commenced to approach that of surrounding universities of equivalent size and rank. So Clark probably had the proper idea there. Moseley and Love, neither one did much for or against the School of Mines.

See, the School of Mines occupied a peculiar position at the University. Although it was called a school, it was sort of a college within itself, in that it had departments of geology, metallurgy, and mining. And then, of course, there were subdivisions in those various departments on different aspects of the science. And then we had a director. Now, from as far back as I can recall—way back to about 1912—the School of Mines had a *director*, like professor Young, and then Lincoln, Fulton, Carpenter, now Scheid, [who] were directors of the School of Mines. And the *director* of the School of Mines ranked with the *deans* of the other engineering colleges from as far back as I can recall. I believe that was the understanding when the Mackays endowed the Mackay School of Mines.

And, of course, the School of Mines has enjoyed a widespread reputation as a good mining school. Long before I ever went to the University, I used to hear about the Nevada School of Mines and later Mackay School of Mines. It had a worldwide reputation. Even the prospectors and miners, many knew about the School of Mines because the school did so much work on determining specimens that were sent in. And that work has been discontinued. That used to be done by the California Bureau of Mines also, and that also has been discontinued. But it was a method of keeping the school in contact with prospectors and mining development, more so than it is nowadays. There were hundreds and hundreds of specimens sent in to the School of Mines, and we made free determinations and made free assays for gold, silver, copper, lead, zinc, and other valuable elements, and also made determinations of minerals and of rocks. And as as result of that, we learned of mineral occurrences and rocks that probably would not have been brought to our attention for a long, long time, if ever.

Memory Sketches of Some of My Students

When you mention some of the outstanding students, I hesitate to mention any students as being outstanding because

there s so many students that we had, and a great many of them were very successful in their careers. And should I mention a few and forget others, it'd probably be an injustice to those I forget. But I remember some in particular. John Wells, for instance, graduated in mining engineering. He did a lot of work for the Natomas Dredging Company over here at Folsom, California, and he became their chief examining engineer on placer deposits, especially dredging deposits, and traveled into Canada and Alaska, South America, and other places, to examine properties not only for Natomas, but for other companies. And after their dredging closed down, he joined the Bureau of Land Management, and he serves as their engineer on examination of mining properties. Now, they have a great deal of difficulty in their work, contending with people who locate claims, not always only for mining, and it's up to the Bureau men to evaluate these claims.

Now, to get back to John Wells. Because he went with the Bureau of Land Management, they wanted him to teach other men the proper way to sample gravels. As this took up a great deal of his time and meant a great deal of repetition, they gave him the time off to write a book on the sampling of placers. There was no good publication on that subject. And that's the best thing, so far as I know, that has ever been published on the sampling of placer deposits. Wells gave me a copy of it, complimentary copy, and I appreciate that very much.

And then, we had a graduate [by the] name of Larry Fish that went to South America and was very successful down there in the copper mines in Chile. Larry's now retired and living at Paradise, California.

Then we have Robert Smith (Bob Smith), lived at Fair Oaks, [California]. He and John Wells were high school students together. And Bob Smith was an outstanding student. He became chief petrographer of the united State Geological Survey—in other words, an authority on igneous rocks. He still is. He's known world-wide for his knowledge, particularly of volcanic explosive activity.

I might also mention John Burgess. John Burgess became a very successful mine examiner and mine operator. He operated—among others—the iron mines in the Eagle Mountains for the Kaiser Company that operates the large smelters out east of Los Angeles, the only big iron smelter in the state of California. And then he left there and he went to the Island of Cyprus, where he is general manager for the SealyMudd interests of Los Angeles, has been for a great many years, operating a copper deposit. That's a very, very ancient copper deposit. (And by the way, it's supposed possible that Cyprus, I presume, got its name from the cyprus growing on the island. But copper probably got its name in Latin *cuprum*, meaning copper. We think it might've gotten its name also from the isle of Cyprus.)

Oh, there's many other good students. I just don't recall them offhand. I'll try to think of some later on and give you some data on them.

Of all our students, one of them who's made a worldwide reputation for himself came from the smallest county in the state of California, little Alpine County. He is now one of the most outstanding geophysicists, and teaches down at Cal Tech. His name is Brune, James Brune.

Now, I might say something more about students. I mentioned previously that I hesitated to mention any successful students because surely, one, just drawing from memory, is bound to overlook some who are equally as deserving, or maybe more so than those that are mentioned. And then, of course, there're good many of our students that have become very successful and we're

probably not acquainted with the work that they have done.

The one name that occurs to me at the present time is that of Paul Sirkegian. He is of Armenian descent. He came to the University from near Fresno, where there's a large settlement of Armenians. He was an outstanding student and a good man to work with. Paul and I took quite a few trips together. He graduated in the late '20's, I believe it was, and became engineer for the Consolidated Copper Mines Company at Ely, Nevada. He was a very successful engineer and rose to a high position with the company, for a time was one of the regents of the University of Nevada. And he was carried away quite suddenly with some disease. I never did learn just what it was, but he was sick for a short period of time. And he was missed very much because he was not only a very active and successful man, but a very fine person.

I might also mention Frank Sharp. Frank Sharp graduated in the '30's, and he had a very successful career as an engineer. He was with the mines at Ely for a good period of time. He not only did engineering work, but very good geological work also. He did much outside investigation of mining properties for his company. He's now (or was, the last I heard) occupied by one of the large mining companies with offices in New York City, and he's also been very successful with them.

And I would now like to mention two other men in geology. There's Kenyon Richard and Harold Courtright. Kenyon Richard was quite an athlete, also. He was a sprinter and a broad jumper. He was a small man—for a broad jumper or for a sprinter, he was quite a small man, probably, oh, five feet seven or eight, and probably weighed a hundred and fifty, sixty pounds. But he held the broad jump record for the University of Nevada for years and years, I believe twenty-four feet eight inches, which is quite a leap [laughing]; for that time, way back in those days, that was a way up, tops in broad jumping. Very few men had broad jumped farther than that. Kenyon Richard took a job with Consolidated Copper Mines Company and rose to be their chief geologist within a very few years. He'd been there but a few years when he wanted an assistant, and particularly a man who was good in petrography.

So, in thinking over our recent graduates, I couldn't find anybody who I thought would fill the bill; that is, somebody who was particularly good in petrography. The director of the school mentioned one of our students who had graduated the year before. This man was a good student, but he was not particularly good in petrography, and I refused to recommend him because of the fact that when a man writes to us and wants to get a man who's qualified in some particular field, we owe it to him, to ourselves, and to the man we send him, that he gets a man qualified in that particular field. So the name of Harold Courtright occurred to me. Now, Harold didn't graduate from college. He quit during his junior year because he didn't have enough funds to continue farther.

He got a position with the Sixteen to One Mining Company at Allegheny, California, which was a mine that operated on extremely high grade gold ores, when they did have ore. And then they'd have ofttimes long barren spells when they had no ore at all—I mean, when they didn't discover any new ore. And they operated on the basis of when they did find good ore, they mined it at a certain rate, so that that ore would last them over a period of years. And then when they had times when they couldn't find any ore, they would still have ore to keep the mine going, paying expenses. That mine had previously operated for years and years with a hand-to-mouth

system of operating. When they would find high grade, they'd mine it all out. And then [when] they couldn't find any more in a few years, they'd shut the mine down. It may be closed for many, many years 'til somebody else took it over.

Finally, they employed a man, Bennett, Dick Bennett (we called him Dick; I don't know what his right name—can't recall his given name now). But he took over the management of the Sixteen to One only with the understanding that he be allowed to operate it in such a way that as, if, and when they did find any high grade ore, that they would only mine it out at a rate such that it would last for quite a long period of time, and giving them the opportunity to do a lot of exploration in finding new bodies of rich ore. And in that way, he kept the mine operating for, oh, thirty or forty years, and was very successful. The mine has now closed, however.

Courtright was working for the Sixteen to One Mining Company, and therefore, our director hesitated to take the man off of a job. But I felt that we owed it to Richard and we owed it to Courtright to see that he got into a job in which he was suited and out of a job that, oh, most any competent graduate could handle, sort of a general work.

So I wrote to Courtright. I also wrote to Kenyon Richard and got the two together, and Courtright went to Consolidated Copper Mining Company, and we sent the other man over to Sixteen to One, so that they had a good man for their job. Courtright and Kenyon Richard worked together from that time on (now, this was in the late '30's or the early 40's; I forget which now). And they continued to work together. They both left Consolidated Copper Mines together and went into Arizona to work for the American Smelting, Mining, and Refining Company, which is a big operator. They had mines in several places throughout Mexico, and also in South America, particularly down in Chile. And Courtright and Kenyon Richard worked together in opening up new ore deposits, finding new ore deposits in Arizona and in Mexico, and particularly in South America. They were very successful there in finding new copper deposits. Their work was largely in copper.

And then, some years ago, Kenyon Richard joined the ASM & R office in New York City, and I believe now he's in charge of all their foreign exploration work, whereas Courtright stayed in Arizona and is their head man in exploration work in Arizona. So there we have two men who have done remarkably well.

I can think of some more, one named Meredith Brown. He and a man by the name of Meredith M. Hawk. Of course, these fellows went there back in the early '30's, I guess it was. (Only forty years ago, and I should remember that far back.) Anyway, I knew these boys quite well; they both took mineralogy and geology, and neither one graduated. They were great pals; they always associated together. They used to mine together down near Mono Lake, up in Lundy Canyon. And they stuck together after they left college. They went down to California and worked for a cement plant down at Victorville, near Barstow. There's a big cement plant at Victorville that's been operating for, I don't know, ever since I can remember, surely, fifty years or more. And they had a fire in that cement plant. And somehow, Hawk lost his life in that fire. And Brown and Hawk had been together for years up to that accident. I just learned when I was down at the meeting in Sacramento last week that Brown is now with the American Cement Company. He occupies a very high position because he knows so much about

cement making and raw materials for cement making. And I'm glad to know that he's made such good progress.

And then another name comes up, Mel Redhead. And one of our former students, I asked him if he knew what became of Mel Redhead, whom I hadn't heard from for years and years. and yes, he knew, and he sent me a letter telling me that Mel is vice president and part owner of a company down in southern California, doing engineering work. Mel was another one of my good students.

And then, Byron Hardy is another who's now a geologist for the mining company that operates a gold mine [Newmont] out in eastern Nevada near Elko and north of Carlin. (By the way, there was a fine article about the Carlin mine in a recent issue of *Economic Geology* in which they mention Byron Hardy because he contributed information toward their article. They also mentioned Bob Fulton, who's vice president of Newmont, and a very successful mining engineer.

I'll try to get some information for you on this man I knew that operates the lime mine over here. It isn't a quarry. It's an underground mining of limestone, which is rather unusual. Practically all limestone is mined by open pits, and this is one of the few that I know of that's mined from a shaft and has been operating for years and years, and this man operates it. He used to work in the mines around Plumas County when he was coming to school. And he didn't finish college, either, but he's been very successful in his work. And he and I used to have a good deal of discussion because of some unusual characteristics in some of the mines that he had worked in in Plumas County, for instance, like the Four Hills mine, which has some unusual features in that there was native copper occurring with native gold in the quartz vein. And to me, that was a very unusual occurrence.

Oh, some of the other students I had had is Ed Olsen, who has been so successful in various callings in the state of Nevada. Ed got into an auto accident and had his legs so badly shattered that people thought he would never walk again. I believe he was going to school or shortly after he finished school that that happened.

Gordon Thompson took a course from me. Gordon has been a very successful attorney and judge. He has a way with people. He has an engaging personality and gets things done. I remember his settling a case for the power company over that explosion of gas that occurred some years back, down on Sierra Street [Reno], where a gas pipe broke. The gas pipe and the gas belonged to the power company, and so, of course, they were held responsible for the explosion. However, it's one of those things that's difficult, where you'd place the blame. The pipe was put in years and years ago, and it had an expansion joint that was supposed to give in case there was stress on the pipe or shortening of its length or a bending of it so that the pipe had to give somewhat. But that expansion joint did not work. [That was February 5, 1957.]

You see, when that street was put through, that was low ground approaching the river, and the river had a concrete wall. And then they filled in against that wall before they paved Sierra Street and finally put a bridge across the river. You see, that bridge was put in since I was living in Reno, and they also filled in that street with a lot of rubbish. Before that time, there was a water ditch ran through underneath the street. Its use had been discontinued. I know it has. That old water ditch was partly in a flume, and the flume was cut off at the Masonic building by a concrete wall, and it came through under what was the Fulton garage, but now cut up into various buildings. Another building has since been

built there because this fire destroyed a good many of those buildings. And the old flume was open and the gas went from there into the Elks building, into their basement. And following the explosion out in the street, there was a very serious explosion in the Elks building and set it on fire and destroyed it.

And then, that old flume was cut off by a—well, it went through the back end of the theater building. And an explosion over there did some damage in the rear end of that theater [Granada]. And as I said, it cut of f against a concrete wall at the Masonic building at the east end. At the west end, it terminated against a concrete wall at the garage down on First Street.

Well, this pipe had bent—by the way, Otis Kittle, a former student of mine, and I worked for the power company (looking into it from a geological standpoint). And we found that the street near where the pipe had broken, a big, heavy truck had parked in there shortly before the explosion took place, and we found a depression in the pavement, sort of a circular depression where it had gone down about five or six inches. That evidently was the immediate cause that cracked the gas pipe and allowed the gas to escape. And then it wasn't discovered 'til—we don't know how long that was going on. But finally, a man went in under some of the adjacent buildings, and he had a light with him, an open light, and that's what set off the explosion. Why he wasn't killed, nobody can figure out. But he got out of there unscathed. But some people were badly injured; some were killed. But Gordon Thompson was able to settle that out of court, amicably, apparently, and with very little notoriety in the newspapers.

Of course, this thing was taken up and given a great spread because of the serious injuries. I heard the explosion. I was eating lunch, and I heard the explosion and stepped out on the porch and looked downtown and saw this big cloud of smoke billowing up. And then came another explosion, and I took one of the children with me, and we drove down about to Fourth Street. But when I saw there was a bad fire and a large crowd gathering, I decided to go back and go around across another bridge and come in from the south side of the river and got a better view of the fire and all, got some very good pictures of it, too.

Well, then, another student of mine was John Gabrielli, who became a judge. Of course, Thompson and Gabrielli—some of these other men were not mining students. They simply took geology as a science requirement.

Well, anyway, another student, Mark Lyons, who lived around Oroville and went to college at the University, graduated, specialized in geology, and was afterward a geologist on the Oroville Dam. (And by the way, he told some interesting stories about Bidwell, John Bidwell, after whom Bidwell Bar was named. It was kind of a joke about that because Bidwell ran for the Presidency on the Prohibition ticket. I think it was in [1892], and people played that up against him because they heard he had a bar out in California named after him. And, of course, that went big in the East. And out here, of course, people knew it was a sand bar, gravel bar. [Laughing] Anyway, he tells a story that Bidwell came in from Bidwell Bar to Oroville to get supplies back in '49 or '50, when he was placer mining up there. And, of course, in those days, the only rifles they had were muzzle-loading rifles. And California was full of grizzly bears those days. So their adopting the grizzly bear as the state animal and for their flag is quite appropriate. And the story goes that coming into Oroville and getting his groceries and going back out to Bidwell Bar—it's only eight miles out—in that sixteen

miles, he had time to stop and kill four grizzly bears with his old muzzle-loader.)

Anyway, [Lyons] worked on the Oroville Dam and on the geological work. He helped relocate, or geologize, the route of the relocation of the Western Pacific Railroad, which had to be taken out of the river gorge and given a new routing at least part of the way because it would be flooded. As a matter of fact, the dam went right over the top of the highway bridge. I remember when they blasted down the highway bridge and just buried it under the filling of the dam. So the old highway bridge on the old highway that came up the canyon, built in the '30's, is buried under the west toe of the dam. And so he worked on the geology of relocating the railroad.

Now, it was quite a problem, because in the route that they had to build the railroad, which was somewhat longer than the railroad that was built originally, of course; it had to be built in such a way, according to their agreement with the government, to build the railroad with a grade of not over one percent. It had to be the equivalent of one percent. In other words, one percent would be fifty-two and eight-tenths feet rise to the mile, and it couldn't exceed that. But in addition to that, when the Western Pacific Railroad built their line, they built it to what they call "equivalent to one percent." In other words, a locomotive pulling a train should have no more pull on any part of the road (on curves, and so forth) more than they would have on a straight road, one percent grade. Therefore, on all the curves (because of more friction going around the curves), the grade of the railroad grade had to be less, so that the pull on the locomotives would be just the same. But it took a lot of careful work to figure out all this engineering. They had to put in a loop and a tunnel and they had several tunnels. And they had one long tunnel that came through almost under Jarboe Pass, which is out of Oroville, and come back into the rail road and tie on to their line above the upper limit of the water in Oroville reservoir.

Well, in doing this, there's a great many geological problems. Now, one was that in one place, the-rock they had to cut through was sedimentary rock, had a very steep inclination of about probably eighty degrees from the horizontal— almost vertical. And when you undercut the toe of that rock, and being as the rock was stratified, there was very little friction between one layer and another, and it would tend to slide down the hill, just like the Western Pacific had the sane trouble going up the canyon where they undercut some of that granite that was jointed. Big blocks of granite slid down, and they're continually having slides in the North Fork Canyon.

Well, anyway, when he was showing a group of us this route that they'd taken and some of the geological problems, he pointed out that the original survey where we were standing came in a canyon just opposite where we were located at that time. I had been looking at some flats along the mountainside, little terraces, and they were covered with a growth of brush and oak trees. And I was interested in why the oak trees were growing there and not on the rest of the mountain, et cetera, and why those terraces. And it occurred to me that it may have been a fault dropping down those terraces. And being that they were on the north side of the ridge, of course, they collected more snow and moisture laid longer, and they had less evaporation due to being in the shady side of the hill. And that favored the growth of oaks and other deciduous trees, rather than the pine trees and firs, and so forth. So I asked him if they didn't represent a part of a displaced erosion surface. And he said it did, but at

the time they laid out that route, they hadn't recognized it. But they discovered afterward that it was. Therefore, they abandoned that route and took this other one, where they had the complication of the sliding rock. But they figured that was better than the other route.

He afterward was killed in an auto accident in Yugoslavia. He went over to Yugoslavia doing consulting work for a mining company, and then lost his life in an auto accident.

(Well, that's some very interesting country up there, from not only the standpoint of this railroad having the lowest grade of any railroad crossing the mountains, because no place does it exceed the equivalent of one percent. Whereas the Southern Pacific has grades up to two percent and over, which requires—well, it takes a lot of power to pull their trains up over there. And it used to be horrible on the f iremen in the old days when they burned coal. I remember how they used to speak of the firemen when they got up over the first steep hump up here, and then the road flattened out a little and they called that "little heaven." And then when it got over the big summit at Donner, they called that "big heaven" because some of these men used to collapse at the firebox from shoveling coal. You can imagine how hot it would be, especially in the summertime, shoveling coal into those huge locomotives. Nowadays, of course, there's quite —[it's] over now. Later, they fired with petroleum and then later on, steam locomotives gave way to diesel engines. But this old region up there had a lot of interesting things, for instance, it was Bidwell's discovering Bidwell Bar and making quite a fortune there, enabled him to buy a lot of land around Chico. Also, a group of Oregonians came down in the fall of [18]48, under the leadership of Peter Burnett, who became the first civil governor of the state of California; he brought these Oregonians down who were all young—practically all young men. And they brought wagons, and they came overland part way on the old trail laid out by the Applegates in 1848.)

Another student's name was McCrae, I'm pretty sure, and he went back to the University of Kansas, who had a very good course in oil geology. And when he sent his work in (his college credits, and so forth), they wrote back and told me that they didn't think they would accept this man because his grades didn't average up to what they wanted for graduate students. "Well," I said, "there's an explanation for that. This man had difficulties of various sorts in his early college years and didn't make very good grades, no fault of his. But," I said, "you'll notice his junior and senior grades are good, and they improved as he went along." I always put more stock in a student who probably starts not very good but winds up strong than a man who starts strong and fails to finish strong. I always gave students credit for that and always encouraged them to improve, because I frequently told my students that I didn't care even if they did get low grades to start with. I said, "If you wind up with good grades, you'll get a good grade in the course. Because," I said, "ofttimes, geology's very difficult for certain students, and they have a difficult time getting a start on the thing, or they have sickness or other troubles that they can't do so well."

So, they wrote back and said that, on my recommendation, they would accept Mr. McCrae, tentatively, for one semester. However, at the end of that semester, they ex tended it for the year. And at the end of the year, he got a scholarship to Cal Tech, put in a year there. I afterward met his professor at a meeting of the American Association of Petroleum Geologists in Los Angeles. We had

quite a talk, and he said, "You can send us all the men you want like McCrae. We'll take them." Or he said, "We'll accept any man that you recommend" [laughing].

So, I told them I wouldn't've recommended a man as highly, except that I knew that he had the ability, and that his grades were not commensurate with his ability, and because of difficulties he'd had in school. I don't know what all it was; I never did know, but I knew that he'd had some gosh darned difficulty in getting his work done.

I might mention some more of the graduates whom I had as students. Now, these were not all geology students. Some were miners and some were in metallurgy, but I had them in my classes. I remember one, Louis Vierra, who graduated in 1925, and for some time, he delivered gasoline in Reno for the Richfield Company. I know one of the professors at the college remarked that he thought Louis wasn't making good use of his time because he was driving this gasoline truck. Well, it so happened that Louis was unable to get a job as a geologist, so he took what work he could, just like I did and like you did, probably, and all the rest of us, at times—that is, not all of us; some people, of course, get into a well-paying job and right soon after school and everything was rosy. Some of us had a little rougher time than that, and Louis was one of them.

And one day, along in the early '30's, I believe it was, Louis and I were talking, and he mentioned that he would like to get a job as a geologist in the oil fields—or, a geologist some place. And so I said, "Well, what are you doing now?"

"Well," he said, "we're planning next month to take off for a vacation."

And, "Where're you going?"

He said, "I'm going up on the coast of Oregon."

"Well," I said, "I have a suggestion. By the way," I said, "I have learned that the best way to get a job is to be at the place when they want somebody, when you're there. You've got a good chance to get the job because they look you over. And whether they're strictly satisfied with you or not," I said, "they say, 'Well, now, here is a man, and we don't know others writing in—let's take him.'" That's the way I got my job, you know, down in Arizona, by going right down there. And if I'd've phoned down, I'd've been way too late. And only that I rode down there on the train, was there early that morning, and they had time to stop the man coming down from Bisbee that was going to take the job temporarily, and I got the job permanently.

So I told Louis my experience and in many cases, where I had got a position because I was right there and applied for the job in person. I said, "Why don't you go down to southern California for your vacation, and then go around and visit these oil fields?" I said, "Visit various oil fields, and go out and talk to some of the men who are drilling, and sort of familiarize yourself or acquaint yourself with what's going on in the oil fields, where they're drilling, and who the major companies are, and so forth. Visit." I said, "You can go and apply for a job, and you will have at least a smattering of knowledge of the surrounding country and what's going on.

Well, he did that. And he walked into the Richfield Company's office and applied for a job, and they said, "Well, when can you report for work?"

And he said, "Oh, within a week."

"That's fine. We just want a man—." Put him on, just like that.

And he was with them all during the Depression. He became an expert on drilling mud. You know, they mix up a combination of

barite, clays, and other things to make a heavy mud that they put into the well to put it under heavy pressure to hold the water, and so forth, coming into the well while they're drilling. And he became an expert on that and was with them all these years and finally retired some years ago, and was never laid off. So, he was one of many, many of our graduates.

And another was John Gilberg. Gilberg graduated back in the '20's, also, about the same time as Vierra did. And he was a heavyweight boxer at the University, was quite successful at boxing. He became a geologist in oil and went down to South America and various places, finally became quite wealthy and settled down in Palo Alto, where I believe he still lives.

Louis Skinner. I must mention Louis Skinner, graduated in the late '20's. Louis's father and uncle went to the University of Nevada, way back in the early 1900's. They lived down at Lone Pine, California, in Owens Valley, and Louis was born there. And one of his brothers was quite a good painter, amateur painter, and made some interesting paintings of the mountains down in that neighborhood. And Louis graduated in mining engineering and afterward became an attorney and practiced mining law and was in Reno for quite a number of years, moved down to San Luis Obispo, I believe, after he retired. He had a son who also graduated from the University, in geology, too, I believe. I don't know; maybe he was also a mining engineer.

Now James Cazier graduated in the '30's. His home was over at Wells, Nevada. I think his father operated an electric light plant over there—electric light company. The last I heard of Jim, he was a very successful man, worked in Colorado.

Then there's Bernard York. The last I knew of Bernard York, he was living in Mina, Nevada.His home was in Fallon. He graduated as a mining engineer. He taught at the University of California for quite a number of years and then retired to go into mining in Nevada.

Eugene Grutt. Grutt is a brother-in-law of John Burgess, who graduated in the late '30's, and so did Grutt. And I believe Grutt is now with the Atomic Energy Commission back in Grand Junction, Colorado, or he was at Grand Junction for quite a long while. He's one of their leading men.

Victor Kral graduated in mining engineering, did a lot of work in geology, and was with the Ford auto company, operating manager of one of their mines in northern Michigan for years and years, twenty years or more, I imagine. And he retired from there and moved to Tucson, Arizona, where he is employed by a mining company, looking for new mining properties.

You know, a lot of the mining companies now have geologists and engineers in Arizona and Montana, Utah, and Nevada, various places, looking out for new mining properties. It used to be these mining companies sat around and waited for somebody to bring properties to them. Now, they find that they can't get properties that way; they have to go out and look for them and explore and develop them themselves, pick up property that even prospectors have not paid any attention to, or may not have. Right now, in Reno, Nevada, there are more outside companies with geologists and engineers looking for mineralized ground to develop, that is to drill and explore. I don't know, there's probably fifty large outside mining companies in there, and not only mining companies but other concerns that want to get into mining.

Milton Steinheimer was another very good student, and he had charge of the diatomite properties out beyond Lovelock.

And he's been with them for many, many years.

Sam Wilson was one of my students. He's a brother to Tom Wilson who runs an advertising agency in Reno. Sam went into the World War II and became colonel. Last time I knew, he was a full colonel. I believe he's now retired.

Fred Humphrey. Fred Humphrey's now teaching at the University of Nevada. He graduated in the early '40's in mining engineering. He did a good deal of work in geology. He taught mining engineering at Stanford for a great many years, was dean of the engineering college for some time, also helped establish a mining school down in Brazil, where he was for a good many years.

I might mention Bill Hughes. William J. Hughes lived up at Dutch Flat. He has his summer home now at Dutch Flat. That was his father's home. And he is with the Texaco Oil Company, went into oil geology after he graduated at the University of Nevada. He has done quite well.

Floyd T. Wilmoth graduated as a mining engineer, but he's teaching geology and mining at Sierra College. He has been with them for many years, I think since shortly after his graduation, in the '40's. He has also done considerable mining on his own, quite successful at tungsten mining.

Oh, I can't mention all of these, my goodness. Stanley Davis graduated in geology in the '40's and got his doctor's degree at Yale University. He taught at Stanford, specialized in ground water. He taught at Stanford for a good many years. I think now he's at Yale; I'm not sure. I believe he is.

And Robert Reeves. He graduated in mining engineering. However, he did much of his work in geology. He worked with Victor Kral on the geology and engineering of Ford auto company' s iron mines out east of Lovelock. And it was from that work that Kral finally went to work for Ford back in Michigan. And Reeves joined the Geological Survey. He was with them for a great many years, did considerable work in Brazil and other places; I don't know where all he did. He's now teaching, I believe, at the Colorado School of Mines, retired from the Geological Survey.

One of my girl geologists was Marjorie McKnight. She didn't go into geology, but she taught school for years in Reno, now retired and living in Reno.

Oh, yes. I must mention Betty Bowman. She graduated in, I believe, mining engineering and did some work in Alaska. She married a man who is in the hardware business and lives down in southern California, east of Los Angeles. Oh, yes. I haven't seen her for years and years.

Now, Bob Horton is well known around Nevada. He graduated in the '50's in geology, worked for the Nevada Bureau of Mines for years and years, did considerable consulting work. His father was in mines all over Nevada, and Bob traveled [from] one mining camp to another. And he became a chief geologist for one of the oil companies drilling over in Railroad Valley, Nevada's only oil field. And I don't know if Bob is still doing consulting work in Nevada, no longer with the Bureau of Mines.

Oh, yes, a mining engineer I knew quite well, Arthur Brunton, who, I believe, is—either he or his brother; I think it's Arthur is secretary for the American Institute of Mining and Metallurgical Engineers back at Boulder, Colorado.

And then Elwin Fisk was a long time chief geologist for the Cordero mine in northern Humboldt County. They were, at one time, the

largest producer of mercury not only Nevada, but in the West; very, very productive mine.

Clair Kunkel, who was with a mining company at Bishop, California, at a mine, a tungsten mine high up on the mountains over there [was another of my students]

An then, Kenneth Fox graduated in geology and is in the oil business; I don't know what company, one of the companies in southern California.

I must mention Chester Collins. Chester Collins graduated in geology somewhere in the late '40's or early 50's. And he was quite a heavy man, and his feet were rather weak, and he had great difficulty doing field work, which he loved to do. But he stuck with it and went into aerial photography and worked for years for the Geological Survey on interpretation of geology from aerial photographs, and was in Sacramento for many years with the Survey, has quite a large family. And he moved to Scottsdale, Arizona, just out of Phoenix, where he is with the state, I believe, now, and continues his work of aerial photography.

Oh, when I think of Cuba, it reminds me of Conrad Martin, who graduated at the University and was a very successful geologist who was for years at Gabbs, Nevada, for—can't think of the name of the company now. They're big operators of iron, supply material for the iron mills in Ohio. He went to Cuba for a company doing work down in Cuba. Oh, he had quite a few outside jobs. And now, I believe he's in Turkey, somewhere in southwestern Asia in the oil fields.

See, a lot of these students, you know [laughing], graduated in mining engineering, because when they came there as freshmen, practically all of them were—no matter what their preference was, they were steered off into taking mining engineering. I didn't care whether they took mining or geology, as far as I was concerned. But they were there to get an education.

Oh, I mustn't forget Robert Prince. Well, Robert Prince worked for the—oh, let me see, Jefferson Lake company from Texas. Anyway, he was on their staff for years and years. He lived in Reno, and they were interested in some properties down at Manhattan, Nevada. And finally, Bob went down and was at their Houston office for years and came out to the southern Mother Lode to operate a short fiber asbestos mine, which is still operating. He organized and developed that property and saw through the installation of a mill and the operation of it. He was their manager and lived in Sonora, California. And several years ago, he went up—I think it was Shasta County—examining a mine, and he was killed by some mine accident while working in that mine.

Another name [that] comes to mind is Sam Arentz, whose father was a mining engineer and later on was our representative in Congress, congressman from Nevada for years. Young Sam graduated in the '30's and worked out of Pioche, Nevada. I think now he's in Salt Lake City. And Sam was a very successful miner.

Paul Gemmill graduated in the early '30's and did some work as a term paper on the Tallapoosa mining district in the Virginia range. It got its name, Tallapoosa, from a promoter who owned property out there, and he was from Alabama, I believe, Colonel Proskey. And the colonel liked that name, Tallapoosa, from the name of a town in Alabama. And so he named this place up there Tallapoosa. Paul Gemmill made a geologic map of the area and did the petrography of it. He was quite good on petrography, the study of rocks in thin sections. And then he went back to Pioche, where his home was,

and operated mines in the Pioche area for, oh, years and years, and did quite a lot of mine examination over the state. And when he retired from that, he became the secretary of the Nevada Mining Association, where he still is.

What reminded me of Tallapoosa, I had a letter from him (Gemmill) the other day, and he has an idea that probably somebody might do some drilling out in that area in the hopes of developing low grade property, I mean, a large body of ore. Hidden ore deposits, that's what they're looking for nowadays, not those projecting above the surface, but those that have satisfactory looking mineralization, and then drill it themselves and develop it, without going through this thing of being opened up by some prospector.

And then, another man I must mention is Angus Bethune. He graduated in mining engineering, but he operated an electrolytic zinc plant for the Bunker Hill and Sullivan Mining Company up in Idaho for many, many years. He's now retired. We usually get a card from him every Christmas. I often wondered if Angus Bethune wasn't probably a descendent of some of the Hudson Bay people because they had an Angus Bethune with them way back, with the fur trappers in the Northwest, a hundred years or so ago.I've run across the name there.

Oh, in the same class was Augustus M. Dixon, whose nickname was "Doggy." I don't know why. [Laughing] Doggy Dixon. And he came from Doyle [California]. His father had a store at Doyle, and his brother operated the store for years after that, Junius Dixon. Junius attended the University for a while. But Augustus Dixon was with the magnesite company over at Gabbs, Nevada. He was their engineer. The last time I heard, he was still there. He was with them for many years.

And I must mention Marvin Newlove. Now, there was a sad case. And that's the thing that I object to very, very much, was—is—a case like that. Marvin Newlove lacked, I think it was, only a half credit or one credit and a half to graduate. And the faculty wouldn't let him graduate. You see, we require 144 units in mining. So he left, because he'd have to come back the second semester in order to make that one unit or half unit in order to get his degree. So he left here and went down to Stanford and graduated the next year. So I guess he's good enough for them, he's good enough for us. He was superintendent for the North Star Mining Company in Grass Valley, California, for quite a while, and what became of Newlove, I don't know. Afterward, Bob Fulton, another graduate, was superintendent of the North Star.

Did I mention Frank Keith? He graduated in mining. He took a great many courses from me. He's an engineer for the copper company, or was, out at Yerington, where they have that big pit out there, for many years. Whether he's still there, I do not know. I haven't heard from him for some time. He was the last time I knew of him, or from him.

Well, there are men [who] worked there that I happened to know while they were going to the University, and achieved prominence afterward, like, oh, some of them became governor of the state and some Senators, like Alan Bible. And, of course, I knew Bible as a student, now United States Senator, has been for many, many years.

Walter Baring took a course in geology from me. He was not a geological engineering student, or he graduated in arts and science and not in geology. But Walter took a course from me, and I'm always pleased to meet Walter Baring. I think he's done a wonderful job back there. I've always voted for him

[laughing], most always, although he's not of my political party. But he does a very, very fine job, and I think we ought to keep him there.

I might mention Bill Flangas, who was an Ely boy who graduated in metallurgical or mining engineering (I forget which), and is doing engineering work for the Atomic Energy Commission in the testing range, out from Las Vegas. He has to do a lot of their mining operations for setting off these atom bombs. Bill has been quite successful there. Although he didn't graduate in geology, he did take a good many geology courses from me.

Claude Hammond was a student at the University when I was there. I don't recall [whether] Claude took classes from me or not. But he took most of his work in mining engineering and metallurgy. And when he graduated, he went over to Ely and was a chemist and metallurgist there for the Nevada Consolidated Copper Company that runs the big smelter. And afterward, he came back to the University of Nevada, along in the '40's, I think it was, and taught metallurgy, continued to teach metallurgy until he retired just a few years ago.

Otis Kittle, I think, graduated in mining engineering, too, although he took many courses in geology, practically all of our advanced courses, and most of his work now is in geology. He's with the U. S. Army Engineers, lives at San Francisco, but works out of the Sacramento office, mostly. I meet him once in a while. He and I have worked together, as I mentioned before. He worked with me on that gas explosion that occurred down on Sierra Street, and then he was on the opposite side with me in a hearing on a sand deposit out north of Reno.

There was quite a large sand deposit—well, not large as sand usually goes, but quite a large deposit, a good many thousands of tons. And it was very, very pure quartz sand, a very unusual one. And it was buried under a coating of alluvium soil out in Lemmon Valley. And they used that sand to build the SAGE building (you know, they had an operation out there [at Stead air base] with radar to check on incoming planes, and so forth. I think that's all been abandoned). They used that sand to build that building, and it had to meet government specifications. It was above government specifications; it was above Nevada Highway specifications for concrete sand, oh, way above, and was an excellent sand, and it was shipped quite long distances out of Nevada to places that want a particularly good quartz sand for concrete work or for finishing work with concrete. I see Kittle every once in a while.

Memoir on S. Frank Hunt

Now, you asked me something about the S. Frank Hunt Foundation. Well, Frank Hunt was a man pretty well along in years when we first heard of him. About 1933, there was a specimen of high grade copper ore sent in to the University as a gift and with some questions about its occurrence. And immediately, I saw it was a very unusual piece of ore, and I suggested that somebody from the Bureau of Mines go out and investigate this deposit, because it was the first finding of high grade copper ore in Nevada for many years. It came from Mountain City, fifty miles or so north and somewhat west of Elko. But I couldn't generate any interest in it. And finally, many months later, it became common knowledge that a large deposit of copper had been found up at Mountain City. So quite a few of us went up then and took a look at the mine and went through the mine, investigated it.

Mr. Hunt used to come down to the University quite often. He was talking to the director, and I think the director got tired of listening to Mr. Hunt, because he would go on and on and on about certain things. So the director had to go downtown, or said he did, and sent Mr. Hunt up to talk to me. So, while he was talking to me, I was interested in his background and what he had done, and so forth, and it was through my conversation with him that he gave us this Hunt Foundation to give students an opportunity to get out into the field and see mines operate, and to give them experience in field geology. That was Mr. Hunt's idea.

Now, Mr. Hunt was a self-trained man. He had a sort of a vision, or insight, into geology in some places. And other places—I'll tell you about that a little later on. Anyway, back in the early days, he was at Tybo, Nevada. He told us a good deal about the geology of the Tybo region, when Director Fulton and I were visiting there, and he even took us out into the field and showed us where certain faults intersected in a shaft that had been sunk along it, and other structural features about Tybo. This was afterward written up by a man from the Geological Survey, and a good many of the things that Mr. Hunt told us were found to be absolutely right.

He also did work around Eureka in the early days. And, you know, for a long, long while after Eureka had ceased to be a large producer of lead and silver, there were, however, many small operations. Leasers and small operating companies would go in there and extract a certain amount of high grade lead ore which contained considerable silver and some gold. There was a great effort made to locate the continuation of the ore deposits across a fault. Now, there's a fault that cut off the ore deposit on the east side, and it was a fault of considerable throw—in other words, displacement. The eastern side had dropped down with respect to the west side. And intruded along this fault, was a dike of rhyolite. A good many tunnels and drifts have been driven along the fault, and shafts have been sunk down to a depth of 1,000 or 1,200 feet. But Mr. Hunt maintained that none of those shafts were down deep enough and that they should be about a half-mile deep. Well, a half-mile deep would be about 2,600 and some-odd feet.

Finally, a company was organized, Ventures, Unlimited. I think it was called the Ventures, Unlimited Company. They had a subsidiary company that worked in Eureka. And they finally reached the conclusion that there was a fault of large throw and that the shafts should be sunk or prospects should be carried on to the north of that fault, out several hundred feet from it. So they bored a series of drill holes, diamond drill holes. And they uncovered—or encountered, I should say (didn't uncover) —they encountered [at] a depth of, you guessed it, about 2,600 feet, three ore bodies which they concluded were one ore body, one flat-lying ore body, that extended from out to and beyond each of those three drill holes. Now, whether this assumption's correct or not, I do not know. So far as I could tell, they could have been three different small ore deposits that were pierced by the drill holes, or they could have been all in one continuous ore deposit.

Well, anyway, the attempt was made then to sink a shaft down to these ore deposits, and they got down to about that depth and pumped out some water, had to pump much water. And then they started a crosscut toward the ore deposits and encountered a flow of water. And they were unable to control this water and [it] filled the shaft up to within about a thousand feet of the surface. Then, they put on powerful pumps,

and they brought in diesel engines—oh, lots of diesel engines—and hauled in the diesel oil to operate them. I believe it took about a truckload or two truckloads of oil every day or every other day to keep those diesel engines running (a very expensive operation) to supply enough power to pump the water out of the shaft. And at times, they were pumping something like six or eight thousand gallons per minute (I may be wrong on that, but it's in that neighborhood) and were unable to unwater the shaft; they'd take the water down to a certain level and would seem to be unable to lower it beyond that. I have an idea that probably some of the water they pumped out was returned back to the mines again, but I can't be certain of that.

Now, what's been done since that time, I don't know. I don t know what's been done over at Eureka for a great deal of time, I mean, for many years. But I do know that Mr. Hunt's estimate of the depth of where the ore should be was correct.

Then at Mountain City, long before he found the ore deposits, he tried to raise money; he organized a company and sold stock. And some preacher in Salt Lake City supplied quite a bit of the money to help Mr. Hunt out on his prospecting. So in his prospectus—I wish I had a copy of that prospectus; I'd like to run it down sometime because it'd be worth a story in itself. Mr. Hunt got out a prospectus, and he made four statements. One was that he had a leached outcrop of a copper deposit. And it had just bare traces of copper in this outcrop (it was mostly iron oxide and residual silicate minerals from the ore deposit, and so forth), and that there would be a large body of secondary copper deposit down below. He gave the distance down to the deposits a hundred fifty feet or so), and he said the deposit would be of a certain width (I forget now, just what, something like a hundred feet or more), and would run something like forty percent copper (which it did).

And all those things were true. It was a leached outcrop. There was a secondarily enriched body of ore, a large body of ore. It was down at approximately the depth that he estimated, and it ran fully as much as he suggested that it did. And there again, you have a man making five statements —five or six statements—about this deposit, all of which turned out to be true, as did his work at Tybo and his estimates of the depth of ore at Eureka.

And then, he made a mistake. He published a book on the ore deposits of Nevada, or something like that (I forget the title of the book), in which many, many of the things he had in there were quite erroneous, or fantastic, unfortunately for Mr. Hunt. I was sorry he got out that book, because Mr. Hunt was quite a fine person. And of all his work in mining, this one deposit at Mountain City was the only one where he really made quite a fortune from it. Well, he's a very interesting man to talk with because he had a great many interesting tales of his experience in mining, et cetera.

5

Professional Work in Geology

An Introductory Note on Practical Geology

Well, you see, geology has many, many subdivisions. There're men who spend all their time in geological exploration—exploration for cement materials, or exploration for economic minerals of special types like diatomite or building materials or for oil or for minerals. Now, one geologist doesn't do all these things. Usually, a geologist concentrates on one line of work. He's either a petroleum geologist, or he's a structural geologist, or he's an exploration geologist, and he may confine himself to precious metals, or to copper, or to iron ores, or to coal mining, or to foundation work (foundation for bridges or dams or—). Now, that's a specialty all of its own, a foundation for dams. And a foundation for building is a great field for geologists, structural work. [There's] geology for the driving of tunnels, because there's a lot of competition driving tunnels. There's been some very serious errors made by driving tunnels into places where the ground is unstable; it costs a tremendous amount to put tunnels through in places where, well, maybe they could have been shifted somewhat. Or, then again, they could have known what troubles they were up against and known whether to proceed and assume all of this obligation of the added work. And then, there are others who work on earthquakes. They call themselves seismologists. However, all geologists should know something about faulting, which causes earthquakes, like the little earthquake they had in Sacramento Valley in northern California, where I don't recall their having had any earthquakes in that country before. Maybe they have, but I don't recall any. But that's the way they happen. There's always a first time that they may happen any place, I presume. Well, earthquakes are so active in Nevada; that's one reason I did a lot of work on earthquakes, although I wasn't a seismologist in the sense of—well, the work on seismology today, I don't understand most of what comes out in the *Seismological Bulletin* because that work is done mostly by geophysicists. And some

geologists work along with them, of course. And that's the reason why geologists are called in on so many different problems.

Now, another case I went in on, there was a house up at Verdi on the river. [The] power company got into this again, too, because they did some blasting up there to clean out a water ditch. And the people claimed that their house was ruined due to the blasting. You know, I actually believe that they had a gas explosion in that house and that they had refinished the walls to a certain extent. And it was as soon as that occurred to me that I noticed where they had actually redone some of the walls. And I think they had a— I'm sure they had—a gas explosion in their house because practically every room in the house, the ceilings had been lifted and dropped—that is, they weren't torn loose, but they were cracked around where the wall meets the ceiling in most all the rooms in the house, not the one next to where the blast came from, as would have been the case had the blast been so violent as to strongly shake that house. And I found people who lived nearer to the blast and in a direct line with the blast, and they told me that they hardly felt the concussion from the blast at all. And I knew the blast was very small. They wouldn't fire more than about one or two sticks of dynamite to break these rocks that were in the ditch, and that was a quarter of a mile or more away from this house and couldn't've done the damage. So I reported such, and, of course, this was settled out of court for a very minor amount. Whereas, if this damage had been done by the blasting, they could've claimed a great many thousands of dollars because this was a very expensive home.

And then, with that [Sierra Street] explosion, of course, we could find out what caused the breaking of that pipe in the first place. And I think we figured that out. I don't know how you could blame the company, except they owned the pipeline and the gas, and that was it. They weren't responsible for the break. Of course, the court could hold that they shouldn't've run the pipe over that beam and left it unsupported on either side. They should have put it underneath the beam and buried it much more deeply to be beyond the effects of surface settling, et cetera. And in that case, the big companies are at a disadvantage because everybody thinks they ought to pay for everything that happens that they might have been involved in, in any sort or way whatever.

But anyway, a geologist is called in on a great many things that have to do with the earth and the possibility of faulting. I did some work, too, for a Southern Pacific Company on laying of the oil pipeline down across the big fault along the front of the Sierra. And, of course, all they wanted to know was where these faults were, where the most active ones were, like the one west of Verdi. We had to cross the fault or not run the pipeline; so, of course, they ran the pipeline. But they made allowance for repairing [the] pipeline case for breaks, just like they do when the aqueduct going into Los Angeles, it goes through a fault, San Andreas fault, and they have all the materials and equipment for repairing the tunnel in case of recurrent faulting on the San Andreas fault. The same thing'd be true with the driving of tunnels now for taking water from northern California into southern California. That goes through the fault, also. So they have to make allowance in case of the tunnel being sheared off, they can go in and repair it.

Oh, I did another work for the railroad company [laughing], too, another blasting problem. They did some blasting on the railroad out of Susanville, and people claimed it damaged their property. And they were around the corner from where the blast—there was a hill between them and where the blasting was done. Other residences in line with the blasting

had no trouble at all. And so I know that what damage they had was due to an earthquake that happened six months or so before the blasting. But they thought if they could collect the earthquake damage out of the Southern Pacific Company, they would do so. But it didn't work out that way.

So, you see, that's why geologists get called in on those sort of things. Of course, they could have called in a powder man or somebody like that. But they'd rather rely on a geologist. And the geologist, of course, could call in a powder man if he needed his knowledge. But like the case in Susanville, you see, I knew much about this earthquake, and therefore, I knew it was earthquake damage and not blasting that caused the damage on that building.

Of course, I never concentrated very much on one phase of geology, except on ore deposits. I did a lot of work on that, and also on earthquakes. But if I were starting all over again, I wouldn't spread out as far as I have. At the present time, things are so different. Nevada has not been completely explored. A lot of exploration—geological exploration is yet to be done. But they have learned so much more about Nevada than they knew at that time. In fact, very little was known of Nevada geology then. And I would have to specialize nowadays if I wanted to get anywhere. Everybody has to. And I'd've probably done better if I hadn't spread my energies over such a broad field. I wouldn't've had nearly as much fun, either [laughing]. I suppose I'd do it all over again. I guess I'm just made that way, that's all.

Geology in Practice in California and Nevada

North of Oregon City, California, five or six miles, is the famous Cherokee hydraulic gold mine, discovered by and named after a group of Cherokee Indians who had come from Indian Territory, which is now a part of Oklahoma.(They were Oklahoma Territory and Indian Territory, and they combined the two to make the state of Oklahoma.) And these Cherokees, there were great numbers of Cherokees who came west for gold mining. And there were other Indians, too, like the Wyandotte Indians, after whom the little town of Wyandotte is named, out east of Oroville. And these Cherokees discovered Cherokee placer mine and worked there. And it ultimately became a great hydraulic mine, many claim it's the largest in the world—maybe it was at that time. (Of course, they claim a lot of hydraulic mines in California were the largest in the world, and maybe they were, at their best.) Anyway, it was a huge one, and very productive. The output was about $15,000,000 in gold. The old hydraulic is now quite scenic and worth a visit by anyone.

And the men who operated that, they called it the Spring Valley Mining Company. I understand that they were the people who also organized the Spring Valley Water Company in San Francisco. And a man by the name of Williams, who operated the mine at Cherokee, afterward went to Africa, and the Williams down there became very wealthy mining diamonds. Their outfit finally became the great DeBeers mine and the monopoly that controls all the diamond markets today. Well, many diamonds were found at Cherokee, more than at any other locality in California. Few of them were of gem quality. The diamonds, of course, added nothing to the value of the mine. A monument was erected there a few years ago, commemorating the Cherokee Indians and the Williams, the mine, and the Spring Valley Water Company, and so forth. In that monument are fragments of rock that came from the old Cherokee mine, also a block of rock from the diamond

mines of South Africa, and a piece of rock from the capital of Indian Territory erected by the Indians, and another from the the Cherokee school back there. And also, one of the Williams made the trip all the way from South Africa to be present at the dedication of this bronze monument. So you see, right around that country is a great deal of history of the early days of California.

And then, north of there, not too far north, is the place known as Magalia, right near this town and settlement of Paradise. There was a good deal of placer mining was done on Butte Creek, which runs by Paradise. And under the ridge of Paradise are some ancient placer channels. I remember going in one of those fifty years or so ago when it was being operated by a mining engineer whom I knew. He was engineer for the Phelan ranch. Senator James Phelan owned a large ranch out from Chico, and I worked on that, helped lay out irrigation systems for them. That was about 1916.

Well, anyway, their engineer had a mine under what is now Paradise and what then was called Poverty Ridge—quite a jump from the name of Poverty Ridge to Paradise. Paradise at that time was a small settlement. Then right above there is a little town called Magalia. And near there, were famous gravel mines. One was the Magalia and another was the Perschbacher mine, and there were several other profitable mines in the district. It's quite a productive ancient buried river channel. Many miners were operating in this area when we were driving our stock through there. Magalia used to be known as Dog Town.

Well, down below Dog Town, to the east of Dog Town, there's a large ridge comes out that's known as Sawmill Peak because there was a sawmill on it, and that's a prominent landmark as viewed from the Sacramento Valley; its ridge is flat topped and breaks off at a sharp point, making it a conspicuous object. They had a sawmill in there at one time, and they called it Sawmill Peak. Well, now, at the toot of that peak is what they call the West Branch of the North Fork of the Feather River. And the West Branch was very rich placer mining in the early days. It was there that they found the largest nugget found in northern California, up to that time, at least. And it's called the Dog Town nugget. I think they have a cast of it at the Ferry Building in San Francisco. Larger nuggets were found on the Mother Lode, and I think some larger ones were probably found around the Sierra Buttes, too, later on.

The first mineral I know of being mentioned from the state of Nevada was salt. The mineral name for it is halite. It was mentioned by Jedediah Smith, a beaver trapper and explorer, when he came through Nevada in 1826, when he came down the Virgin River past St. Thomas and visited the Indian salt mines. And he wrote a letter to General Clark, of Lewis and Clark fame. General Clark was in St. Louis at that time and was head of the Indian Service, and Smith tells about finding the salt mines.

Another early mention of a mineral in Nevada is the mineral celadonite, a potash-bearing iron silicate, common in some lava rocks. It got its name because the mineral is green and it's supposed to be a celadon green, a pale green of some Chinese porcelains, so they called the mineral celadonite. And it was previously discovered elsewhere. There was a big silver excitement in the '50's and '60's in the Black Rock Desert. It's supposed to have a valuable silver deposit up there. And it was visited by Clarence King, of the 40th parallel survey, and mentioned that the material that they had was not silver ore, but was celadonite. And I think that's the first mention of celadonite in the state, although it's been

found in many places since then. There's an occurrence in a prominent highway cut about twenty-five miles east of Reno in the Truckee River canyon that has been published upon to a considerable extent.

And well, about these mines, yes, men bring in specimens like that. There was a couple of students of mine brought in a specimen from Peavine Mountain. And at first, I thought it was garnet. And I put it under a microscope and it turned out to be piedmontite. And that's the first we knew of piedmontite on Peavine Mountain, or anywhere in Nevada.

And then, later on, a prospector brought in a sample of a mineral from up north of Dry Lake, and it turned out to be thulite, which is a mineral similar to epidote, or to zoisite. But it is a mineral also fairly high in manganese. And I went up to look at that, and in searching for it, I found piedmontite along the ridge of the 120th meridian, the boundary line between California and Nevada. So, sometimes, that's the way you blunder onto these things.

So, sometimes, we go out to look at things, what prospectors have brought in, and other times men want us to go out and examine a prospect to see if it has any possibility of developing into a paying mine, or worth trying to develop, to see if it'll make into a good mine. You don't have to know it's going to make a good mine, but if the prospect has the appearance of being worth doing some work on to see how good it is, well, that's all they can expect of you. And if some development work shows it to be promising, then, more work'll be done on it. And if they work on it a while and it doesn't show up anything particularly good of economic worth, well, they give it up. And then, sometimes, you have to go out and look at mines that people have invested in. They want to know if they have invested in something worthwhile or not. And usually, they should have sent for you beforehand because ofttimes it turns out not to be worth anything.

And then, another prospect I looked over was a placer mine up on a hillside, up by Johnsville in California. It was a small placer of fairly good, loose ground that you could call a placer deposit, high up on a hill where this deposit got its gold from the outcrop of an old mine up there that was, at one time, a very, very productive mine, just above Johnsville. It was called the Plumas-Eureka. And that old mill, you see, at Johnstown was used to mill the Plumas-Eureka ore. And this placer was derived from the outcrop of the Plumas-Eureka mine. And that, I think, could've turned out to be a worthwhile thing, but it was never operated, so far as I could tell, in the proper way to make it pay.

And there's some operating mines that men are operating on a small scale, and they want you to examine their mines to point out where there might be further ore deposits —whether they're worth going deeper on, or whether there might be some ore they've overlooked. And sometimes, you can point out such things, and sometimes you can't. It's a rather complicated proposition. Sometimes you might think you're pointing at a good area, and that may not be any good at all.

I went out to one south of Silver City that turned out to be a good mine. It was a little prospect down in Spring Valley (which is south of Silver City two or three miles), and there was a shaft there, now caved in. And some men wanted me to interest a company in this—wanted to see if I could interest a company in it (and this was during the Depression; there wasn't much doing in Silver City). This was a shallow shaft, about forty feet deep. And I met the men who sank the shaft originally, in the early 1900's or late

1890's. And they told me they had pretty good ore at the bottom, but they couldn't mine it any deeper because they ran into water, and they didn't have the equipment, or the money to buy the equipment to pump out the mine, and they had to give it up.

Well, after they quit working on it, all the ore around the collar of the shaft had been hauled away, all the dump had been hauled away, down to a mill operating at Dayton. The rock was good enough that, once being mined, it paid to haul [it] to this mill and mill it. Now, it may not have been good enough to mine—in other words, to pay the expense of mining and milling, but it certainly paid the expense of hauling and milling.

So I thought that was a pretty good-sounding prospect. It was right on the trend of the Comstock Lode (it was on the continuation of it). And I got the Dayton Company that was operating in Silver City interested in it, and they sank a new shaft north of the old one about a hundred feet, sank it down a hundred feet deep, and crosscut to the vein. And the vein didn't run anything—all ground up. And they put in a few rounds to the north and it didn't look good. And I told them they ought to drive to the south because that was where the ore had been found before at the bottom of the old shaft. And so we drove of f to the south two or three rounds, probably ten, twelve feet, and hit some very high grade ore—I mean, high grade for that time, thirty-dollar ore, oxidized gold ore, easy to mill. And we continued to drive through that for about fifty or sixty feet 'til we came up to a solid wall that ran nothing. And then we crosscut it at that level, and it was about forty feet wide, so we knew it was fifty feel long and forty feet wide at one end. And knowing nothing else about it, knowing that some of it was up there—at the bottom of this forty-toot shaft—we knew it went up sixty feet. And so there, you had sort of a pyramidal-shaped mass of ore that we figured out had sixty thousand dollars worth of ore, and it turned out to have eighty, ninety, or possibly a hundred thousand dollars. Turned out to be a very nice thing.

Well, then they started to sink their shaft, and I recommended that they winze down on this—you know, sink a winze (an inside shaft) —down to see if this ore continued downward. Well, they thought it must. It was so long and so wide, and so forth. It must go down, and if they sank down, they figured they'd run into water and get flooded out. Well, I couldn't think there'd be more of a chance of getting flooded out on the 100-foot level than you would on the 200foot level. So, no, they sank the shaft down to the 200-foot level and crosscut. (And, oh, by the way, when I estimated the ore, I estimated it would go about forty feet below the level because it was forty feet above, and that was just pure estimate—or "guesstimate.") And they didn't find any ore on the 200-foot level. They crosscut and didn't find a thing. They drove up a raise and hit the ore at thirty-eight feet below the level. Now, I've got ahead of my story a little bit here.

When they started to sink this shaft—my connection with the company had been discontinued, and one day, I was riding by there, and the foreman called me over and said he had something of interest to show me down in the shaft. So I went down the shaft, and down in the shaft—they drove one hundred seventy-five feet deep, or something like that—maybe deeper; I forget—they ran through a place of ground up mass of rock, broken up. And in that was some quartz. And that quartz was white-looking quartz with a few little green specks in it, looked like it might contain some ore. And right away, I told him I was afraid they'd gone through a

thrust fault, and it didn't look as favorable down below because of what looked like a thrust—flat-lying thrust fault (flat-lying means there's a slight inclination from the horizontal). And sure enough, when they got down to the 200foot level, there would be articles in the newspaper about how they were still developing and crosscutting and so forth, and what not. But this kept up for week after week after week, and so I felt absolutely certain there was no ore down there. And I felt more certain that they had probably gone through a thrust fault. And when they drove this raise up, of course, and hit that fault, that was proof of it.

And then, the old foreman, he thought well of me. He and I got along quite well. And he claimed that I told him it wouldn't go below—the ore wouldn't go below forty feet. Well, that wasn't what I told him. I estimated it would go at least forty feet deep. I had no idea it'd cut off. I hadn't the slightest idea in the world what it did, until they cut the thrust fault in sinking the shaft.

Then, later on, some people wanted to open up the shaft and do some more work down there, and I okayed it. I thought they ought to go down to the 200-foot level and crosscut to the west to the vein that ran about north-south and dipped steeply to the east. And I thought they should crosscut to the west of the shaft and pick up this vein that had been faulted off by this flat fault because the fault had moved the ore up to the east. You could tell that the way it dragged the quartz along with the broken-up material that we call "gouge" on the fault plane. (You know, thrust faults are fairly rare around the Comstock, and they're rare around most of our gold and silver mines.) And instead of doing that, they went up and spent practically all the money they'd raised on working up above. And I felt the ore up there had all been worked out—or, the country had been thoroughly enough explored that the chance—possibilities—of finding more ore were rather slight.

And after the money had practically run out, they did go down to the 200-foot level, pumped the shaft out and got down there and crosscut to the west. And believe it or not, they hit this quartz vein in about ten or fifteen feet, a nice big vein, and it ran off to the south continuously— much better than it did up above the fault. But unfortunately, it was all unoxidized ore, not secondarily enriched, and only ran for three and a half, four dollars a ton, which, of course, was uneconomical. But that proved one thing, was that after the faulting, after that ore had been shoved up to the east and erosion had continued, all the ore above the fault (that would be about a hundred and twenty feet, or hundred and forty feet) had all been oxidized, and the gold had been carried down and reconcentrated and made that rich ore that ran twenty-five to thirty dollars a ton out of material that used to run only three and a half, four dollars a ton. That's what I told you earlier, that old Harry Shipkey at Fairview, Nevada, had told us about enrichment of ore deposits. Well, that demonstrated it, right then and there. And this was gold, which is unusual, and a good many people have doubted if gold could be enriched in such a manner. But there's many, many cases I know of the enrichment of gold veins, and this is but one of them.

Nowadays—well, any time—it's difficult to get anything on the sampling of placer deposits, particularly nowadays, because placering has practically passed out of the picture. It's no longer economic in most places in the free world to operate placer mines, even dredges. The last dredges on the Yuba River above Marysville shut down just about a year ago (in 1969). They used to have fifteen or more large dredges operating at

Hammonton [California], up the Yuba River from Marysville. I remember when those boats were being built. And at Oroville, they had—I forget —something like twenty or more dredges when I first noted the dredges up there in the early 1900's. In fact, gold dredging in California started at Oroville. The first successful gold dredge in the United States, and possibly in the world, started at Oroville.

A man [by the] name of [W. P.] Hammon—now, don't confuse him with John Hayes Hammond; John Hayes Hammond was a famous mining engineer a generation or so earlier. This Hammon owned an orange grove in the southwestern portion of what is now Oroville. It was outside the city limits then. And he sank a well for irrigation to get water to irrigate his orange grove. He panned some of the drillings coming up out of the well and found that they contained a fine gold. So he decided then that if it had gold, they could probably arrange some sort of a scheme for recovering this gold.

So he designed and built a dredge, or had one built. And it was a bucket dredge, one that had big scoops that went around and around on long close-connected links from one bucket to the other, and on what they call a "bucket ladder," a big steel frame that dipped down underground. And these buckets were on an endless chain and dragged along the bottom of the pond and gathered up gravel and that came up and dumped it into a trommel, which was a rotating cylinder with holes in it to removed the large gravel and let the smaller go through. And then this is concentrated in sluice boxes on board the dredge (later they used jigs, which are vibrating devices that can handle a much larger volume in a much smaller space than can sliuce boxes). Well, anyway, so much of that.

I'll get back to W. P. Hammon now. After Hammon invented this dredge, a great many more dredges were built in Oroville. And a good many of those were built by eastern firms back in Ohio and Pennsylvania. I remember the Link Belt Company and other machinery manufacturers which are still operating and building machinery, they built a good many of these dredges back there until Hammon, after working in Oroville, went over to sample the gravels at the mouth of the Yuba River where it comes out of the foothills, about thirteen or fourteen miles upriver from Marysville. And so he built dredges to operate there. And he organized a company called the Yuba Consolidated Manufacturing Company, which built dredges for Hammon, and they also built dredges for all over the world. They've moved out of Marysville now and moved down onto the Bay region, and they still do manufacturing.

So then Hammon took over the dredge fields up on the Yuba River and established a little town called Hammonton. And nearby, there's another one called Marigold, which is a combination for part of the word for Marysville and gold, for the gold they were mining. (Isn't that a cute name?) Hammon finally bought out the Marigold, their lands, and its operation. So he dredged all that country, and they redredged some of the—they got dredges so big that they could go down 120 feet below ground level. And so they went back and redredged a lot of the ground that had been dredged by dredges that went down just sixty feet deep. Over one hundred million dollars worth of gold was recovered here. And the last one to be closed down was dismantled—some were dismantled and shipped to South America. I know of no gold dredges operating anywhere in the United States today. There may be

some; I don't know of them. I saw the last two operating at Hammonton, and have colored slides of them. And the last one, as I said, shut down, oh, a year or two ago. There's great piles of gravel up there now, but there's no dredges.

They also helped to establish a channel for the Yuba River to keep it from spreading over the country, and thereby, made it easier to build levees to prevent flooding of the farmlands and Marysville, below there.

Well, now to get back to business again. I used to visit all the mines in the vicinity. I used to go up to Virginia City. And later on, of course, I did my thesis on the Virginia City area, before which the geology up there was published in a very garbled manner (of course, there's a lot yet to be done up there, too). But I enjoyed that. I visited all those mines, went down into all the operating mines, went down in some of them back as far as 1912, and in the '20's and '30's, went down most all of those that were still operating. I've been in the Sutro Tunnel many, many times and up to the end of the north lateral and down at the end of the south lateral, and helped map the underground geology there with the Geological Survey in '35 and '36 (that was after I had finished my own field work).

And then I used to examine mines, doing consulting for the operators. I did quite a lot of work on the mines out in Copper Basin, Copper Canyon, that are now being operated by the Duval Company (I worked out there for a while; there was a minor operation going on when I was there). And I examined mines and prospects over a great deal of Nevada and some over in California. That's very interesting work.

What do I do when I examine a mine? Well, usually, the first thing, you see how large and extensive the vein is. You find out how much the production has been and whether it was profitable. Whether they have any ore left in the mine, you have to sample the vein and have assays run on it to find out if it is still profitable, or likely to be profitable, and report in that manner. Also try to determine further exploration work to reveal other ore bodies.

Now, the first one I went out into Nevada to look at was in 1912 in the south end of the Pine Nut Mountains. I think I told you about that before. I was able to look that over and satisfy myself in just a few hours, that—well, so far as I could judge, it had no promise whatever. Now, of course, you can't just decide offhand like that on all of them, or on many of them. I takes quite a lot of work in the mine, a considerable amount of studying, and also examine the formations on the surface. There should also be a careful surface geological examination made.

I also worked for a while out in the mines at Peavine, operated the mill out there in 1921 or 1922. That was before I was teaching at the University, shortly after I did my graduate work there. I worked out at the mines there for a while. They were not very productive.

Oh, I examined many, many mines up at the Comstock. That's the way I commenced to learn something about the geology of the Comstock and finally decided to write my thesis on it, was through examining many mines that were operating there, not only examining them, but visiting others to see what they looked like. I can't remember all the mines I did go into and examine. They're scattered all over the country. Some are up around Blairsden, and some are down in California, down below, south of, Markleeville, and oh, there's hundreds of them. But I just can't recall offhand just where all these were.

There's a lot of places I've been that nobody—and I mean nobody—will probably

ever be again. Those mines are caved in, you know, like the Treadwell mine I worked in was flooded by ocean water, and the Sutro Tunnel is caved in, and there's little probability of its ever being opened, and the old mines are caved. I was down at the 2,800-foot level of the Comstock mines in 1912. Nobody's been that low—deep —for, I don't know, fifty years or more, I guess. And the Sutro Tunnel's been closed down for twenty or twenty-five years. I don't think anybody could get into it now. And the old shaft we used to go down—the Union shaft—is caved and the headframe from Virginia City is out at Eureka. And it's a very valuable steel headframe.

But I might tell you something about our trips. For geology, and mineralogy, and to a lesser extent stratigraphy and fossils, we had a wonderful location at the University of Nevada. You could see so many things right within sight of the University that were interesting geological phenomena. Well, take like Steamboat Springs. It's world noted among economic geologists and students of hot springs, and of minerals in general. As that spring is causing minerals to be formed at the present time as it has in the past, so that it has been visited by geologists from all over the world. And, of course, it's into worldwide literature, too, because it was an unusual [feature] in showing how some of the ore minerals, and others, are deposited. The waters also contain salt, borax, and sulfur.

Then we have the Comstock Lode that for a long time was the major silver producer in North America and still occupies a great place in the history of mining. By the way, they invented a type of timbering there—that is, they were putting in timber underground, what they call "square-set." Square-set timbering was invented and used at the Comstock for the first time. It's used all over the world for veins of that type. Of course, nowadays, on big scale mining, they don't use square-set timber as much as previously. They use the caving method, or "shrinkage," as they call it, or something of that sort, or they mine by open cut. But for veins like the Comstock, square-set timbering was ideal. Now, they didn't use it at Treadwell, Alaska, although they had as big stopes as they had at the Comstock. But the Treadwell stopes would stand very well by simply leaving a pillar of quartz ore about twenty-five feet thick, extending from wall to wall, although some of our stopes were seventy-five to a hundred feet wide and maybe a hundred and fifty feet high. And they usually stayed open long after the ore was drawn out. I have visited old stopes from which all had been removed fifteen or twenty years earlier.

But that was not true at the Comstock. So they had to have a way of holding up the hanging wall, what they call "heavy ground." It's not a specific gravity, but it [has] a tendency to fracture and give way due to its own weight, or ofttimes, due to its being fractured and settling down. And you had to have timber to hold that up. And later, in the more recent times, they have aided the timbering by filling it with tailings from the mills and let that support the hanging wall—let them hold up the hanging wall, not like the ancient Greek slaves did that mined in Attica, down south of Athens; they used slaves to operate their mines.

That's an interesting thing, that in the history of slavery and the early history of mining are closely related. Most of the miners in the early, very early times—ancient times—were slaves (as in Siberia in recent times). They spent their time underground mining instead of pulling an oar on a galley. And when they reopened those ancient Greek mines in lower Attica, they came along and found I think it was six or eight—this was

along in the 1920's. They reopened those silver mines. I think it was at Lorium, Greece. It was near the Mediterranean. And they had a cave-in in the mine, which was opened up, and they found eight or ten skeletons of ancient miners still holding up the hanging wall that had caved in on them. And, of course, nowadays, we would recover the bodies, if at all possible. But life was held in much lesser regard than it was, until recently, in this country. It's getting to be that way again now.

There's not many people [who] know about the Sutro Tunnel, and I think there're very few people who know about the old river channel I told you about. You can still pan gold there. And we used to sometimes take our students out to these, see what a placer channel looked like and the gravels, and they could pan a little gold from this ancient Tertiary channel, one of the few Tertiary gold-bearing channels in Nevada.

And while we were mapping the geology of the Comstock, we went down an incline from the Yellow Jacket shaft. And somebody had a boat in there. And you could get in the boat, and by shoving it down so it didn't scrape the timbers, you could go back into the drift quite a ways, and as the floor rose about one percent, the boat would ground. [You could] then get out and walk in that old drift for quite a distance. We referred to that area as the River Styx, that mythical stream over which the dead souls are ferried.

Of course, going in a place like that, you have to be very careful for foul air, air with low oxygen content, because you could suffocate in such a place. We used to have to look out for what they call "fire damp," which was carbon dioxide, or carbon monoxide, which is worse. And we used to test that out by lowering our carbide lanterns down near the floor because the material was heavy and stayed near the floor. And if your lamp didn't burn well, then you knew that there was a lot of carbon dioxide. In fact, you could breathe air that the lamp wouldn't burn in, but that wasn't good practice. You would not last long in air so lowered in oxygen.

I know when the Geological Survey was there, I did a lot of underground work with them and underground mapping. And we went into some very dangerous places that I wouldn't go in nowadays, and shouldn't've gone in then because it's pretty wild country. And those places were very dangerous.

But we went into a crosscut—oh, it was in the Ophir mine, I guess, north of the Big Bonanza, which was in the Con Virginia and the California. And there was a crosscut that went in easterly from the north lateral of the Sutro Tunnel. There was an incline shaft [that] came down from the surface. And that inclined shaft went down for quite a long distance, and it was joined by a vertical shaft about at this place. The vertical shaft came down from the surface. And then the skips came down vertically and then went onto a track at an incline and on down deeper into the mine. That was in the Ophir mine, by the way, the Ophir. So we went into the Ophir crosscut. What we liked about this crosscut was that there was an intrusion of the Davidson diorite over into the hanging wall rock of the Comstock. This was one of the few places where this feature could be studied.

In the early days, the early geologists of the region thought that the Davidson diorite was a part of the Sierra Nevada batholith, which is way, way old, and that the Tertiary lavas were deposited around Mt. Davidson, which was an erosional knob that stuck up above the general area. And, of course, that was not the case. As a matter of fact, Mt. Davidson penetrates the surrounding rocks and has developed contact metamorphic phenomena, like garnet and epidote, chlorite, and other minerals

that form from the solutions radiating from this intrusion. But the earlier workers didn't recognize that.

And so, when we found this intrusion in the hanging wall in the north lateral of the Sutro Tunnel—and it was well exposed in this crosscut. There, you could see the very irregular contact—jagged-like contact—of the intrusive rock with the Tertiary lavas, which not only proved its intrusive nature, but it also showed it was much younger than the older Comstock rocks, such as the Hartford Hill rhyolite and the Alta andesite, and it was also younger than the mineralization because some of the Davidson diorite is ground up in the faulting along the lode and pieces of it have been replaced by ore minerals. So we know the ore deposition was a later event—probably not much later, but certainly later.

And we know the Comstock fault took place before all the intrusion was complete because dikes of Davidson diorite were found paralleling the lode, in the fault zone, without the dikes' being chewed up, or ground up. So we know that they were in there after the fault had formed, and there hadn't been enough movement at that particular spot to ruin them afterward. In other words, these particular dikes were in the Comstock fault, but outside of the later movements. Therefore, this intrusive contact was quite interesting, from a geological point of view, to examine and to map.

And so we used to go in there. And the man with me didn't seem to understand those sort of things, about bad air and noxious gases, although he was a good geologist and [had] done a lot of underground work. But he wasn't familiar with bad gas, and so I used to always call his attention and have to stop him and have him test with his lamp down around his knees or lower whether there was any bad gas in there. Now, if the barometer was high, the chances are we would not have any gas exuded out into the drift. If the barometer was low, the gas exuded out into the drift. So we could tell ofttimes by the weather prevailing at that time, whether it was sate to enter the crosscut. If it was stormy weather and we knew we had a low barometer, then the chances were good we shouldn't go in there. Of course, we'd always test it out. If we had a nice, clear, bright weather that goes along with a high barometer, why, we knew it was perfectly safe to go in there. So we made quite a study of that intrusion.

We also, during that time while we were mapping on the Sutro 1,600-foot level, we found some more that I didn't know about prior to this time, where the original Sutro Tunnel ran back to the Savage mine and made connection with the Savage shaft when they blasted through, and a gust of foul air shot up the Savage shaft, almost suffocated the men in that mine. And that was the kind of air the poor miners had to work with in the Sutro Tunnel because, despite all they could do, it was very poorly ventilated. Well, we worked our way back in there, and that was a wild, rugged country, about as wild a piece of underground country I had ever seen or ever went into. The rock was shattered and hung menacingly overhead.

We took sticks along with us and tested under the water because the water was up to our waists. So we had to keep testing the ground to see if there was any holes or big boulders in our way, and so forth. And it was awfully hot in there, a temperature of about a hundred and three degrees, and the humidity was a hundred percent. And if we went in there from a cold drift, or went out of there to a cold drift again, our glasses would immediately fog up so we couldn't see

anything. We all had to be very, very careful not to touch any rock at all. Don't touch any wall rock or anything overhead, because just your mere touching it may loosen it.

While we were back in there, we found another intrusion of the Davidson diorite in the hanging wall of the Comstock fault. Now, I took a sample of it out and Dr. [Frank] Calkins of the Geological Survey made a thin section of it afterward, and [laughing] it turned out to be about the freshest—although it was right near the lode, it turned out to be some of the freshest Davidson diorite samples of all the specimens that we had ever collected. So it was worth the trip after we got in and out safely. When I think back on it, though, I—well, if I had charge of a party like that, I just wouldn't let them go in there now. It's just too dangerous!

See, the Comstock was unique in its day. There was a lot of things about the Comstock that had never been encountered before and had to be overcome. Tremendous quantities of hot water to be pumped, and it was the first place that electricity was taken underground. (Thomas A. Edison, as famous a man as him, came out there personally to show them how to put in electric lighting down in the depths of the mines. And on the old hotel register in Virginia City, you can still see Thomas A. Edison's signature and a great many other famous people.) They also took water underground to pump with. They took water underground to cool with, to cool the mine. They had ice down there in buckets. There's some places so hot that the miners would only work fifteen or twenty minutes, and another miner would stand behind them with a hose pouring water down their necks to keep them cool while the other miner was running the machine drill. And then they would go out to the station and cool down while another crew took their place. I saw some of that in operation there. They had tubs around the stations (this was back in 1912), with blocks of ice floating in them. And these men had one tub out of which they would drink ice water, and they'd bathe their face and neck and head in the other tub of ice water. (Now, whether that was good for them, I don't know. I do know a great many of them died of pneumonia. But I think that was due to the fact that they came up from underground reeking hot and sweating from that excessive temperature and stepped out into the cold air up there and caught pneumonia. The cemeteries contain the remains of many young miners. We had to guard against that, I know, at Treadwell, Alaska, [when] we came up from underground where it was quite warm and then, out there in that cold, below-zero weather. You had to be wrapped up rather securely so you didn't catch your "death of dampness," as they called it.)

I was in places in the Comstock where the temperature was a hundred and twenty-nine, not quite as hot as what I told you about down at the United Verde. And when this water would drip on you, it'd leave a red spot, just from—it'd scald you. Might've been hotter'n a hundred and twenty-nine. The air was a hundred and twenty-nine. The water gets hotter than that, and it'd leave red spots on you wherever the water would drip. We had a lot of places in the Comstock that were insufferably hot.

Now, sometimes, you were cooler. There's an odd thing. There was a place down there where we used to cool down. We came out of a place that was a hundred and three and went out to a place that was around ninety-five to cool down (now, ninety-five is ordinarily quite hot underground). Well, we had a place where it was ninety-five, but the breeze was

blowing—good draft. We felt nice and cool. When we'd go into another place that was eighty-five and the air was quiet, and we'd suffer from the heat because we didn't have that evaporation due to the moving air.

Well, many a day, I tramped in and out of the Sutro Tunnel. Well, I didn't tramp the full length. I have walked the full length of the Sutro Tunnel, but not all at one time; you know, the thing's about four miles long. And a walk of four miles in the Sutro Tunnel is—oh, I think takes more energy than twenty miles on the surface. So we would ride in on the little car hauled by a mule, and then we'd get off and map the geology of the Sutro Tunnel. And then, the next day, we'd go in a little farther, and the next day a little farther, and so forth, until we got a pretty fair map of the whole Sutro Tunnel, and also both the north and south laterals.

Now, the south lateral was more difficult to map because it was under water. And to get in there—now, we shouldn't've gone in there, either. That was a bad thing to do because the air was not as good as it might have been. There'd been a lot of caving in there, and it was full of water—water sometimes up to your armpits—on me, of course, not that high on normal people. And we had to take a pole along to feel our way to be sure we didn't step into a hole some place. I went back in there by myself, and I should not have done that under any circumstances—a foolhardy thing to do, but oh, we survived. If I hadn't done it, I wouldn't have known all about these things, see.

There's a lot of odd things back in there. There was a sort of a slime that grew on the walls. And after it dried, it looked something like buckskin. And a good many people have confused that with a mineral that grows underground, known as "mountain leather," or "mountain cork." In fact, I sent some of this back to a famous institution back East and told them all about what I knew about it and that it wasn't mountain leather, and they wrote back and thanked me very profusely for the beautiful specimen of mountain leather I sent them. And it was simply this mold or fungus, or whatever you'd call this stuff that grew on the walls. It looked like a sheet of buckskin when it dried. But when you tried to wash it, it became all slimy and stuck together. But it felt like glue and it'd run through your fingers, and if you weren't careful, you'd lose it down the drain. So it wasn't mountain leather; mountain leather won't work that way—it won't soften up when you put water on it, and so forth.

Then I tried to go from the south lateral of the Sutro Tunnel over to the Foreman shaft. Now, the Foreman shaft is the east shaft of this mine I was trying to think of in Gold Hill, that we went down the shaft and went into the hot places to show the girls what it was like underground. It was the Overman mine.* I managed to go part way to the

Foreman shaft, and then the country got so wild in there, loose, broken rock overhead, I gave it up. I just went far enough to see where the Sutro tuff, where the—I wanted to get to the bottom of the Sutro tuff and get the strike and dip of the tuft to project it up on the surface. It evidently was faulted between there and the surface that would displace it. And in order to figure out the structure of the country, I wanted to know just where this rock hits up to the surface. I also followed the Sutro tuff around through there and got its thickness and could project it down to where it was found in the Yellowjacket shaft, the east jacket shaft, where Becker had found it, but took it to be a white shale within andesite.

*See below.

And, of course, that helped work out something about the throw on the Comstock fault, also, that I was able to do by finding where this Sutro tuff occurred underground. They call it now the "Sutro formation." It was not all tuff. Some was the tuff and some wasn't. Some was sediments—it was all sediments, but some was tuffaceous and other parts weren't. It contained fossil leaves. And then I was able to find it again near the Overman shaft over at Gold Hill that was reopened in the '30's. And you could go down that to about the eleven hundred-foot level. And there, I again found this tuft, you know, in one of the crosscuts. So I was able there again to project it down to the lode and see where it hit the lode. Now I had two places where we knew the Sutro tuft from the hanging wall contacted the lode. And, of course, on the surface, you could find many outcrops of it in the foot lode, high on the scarp above Gold Hill. And that was a very important thing there, to measure the displacement along the Comstock lode, the pre-ore displacement and the post-ore displacement, or movement of the eastern ground downward, or possibly uplift of the footwall to the west.

See, there's an old erosion surface up on Mt. Davidson that has also been displaced. And we have every reason to believe that erosion surface was developed by erosion after the major movement on the Comstock Lode, prior to the formation of the vein, had ceased as the earlier movement. And then after that long period of erosion, we had another movement along the lode, in comparatively late geologic time, that dropped it down about a thousand feet, and that's the big scarp you see today back of (west of) Virginia City and Gold Hill.

There were hot places along the Sutro Tunnel, too. And they had big doors. You could read about this. If you get Sutro's report on the driving of the Comstock tunnel (of which there's a copy at the Mackay School of Mines library), you can see where he said he built big doors out beyond (west of) the Occidental lode, which is about two miles east of the Comstock Lode, and it strikes and dips in the same direction. It strikes practically north-south, a little east of north, I think about fourteen degrees east of north. (In fact, that was the magnetic declination at that time, so they used all magnetic bearings in mapping in the early days; we don't nowadays. Now, we try to take true north and get all of our direct bearings true north, carry it underground, carry it down by—well, they have ways of doing that. Oh, I suppose a gyroscopic compass would help do that. I don't know, probably would. I haven't heard that being tried. I suppose it is now, because I've been out of touch with that sort of surveying for a long time.) But we mentioned these big doors beyond the Occidental lode, which strikes parallel to the Comstock, and it's a sinuous lode, has curves in it, serpentine-like, that follow somewhat the—but that's purely accidental—follows the curves on the Comstock. And it has been offset by later transverse faulting, although it has very little post-mineral movement along the fault itself. Since that erosion surface was developed, there's been practically no movement along parallel to the lode. But there has been transverse faulting. It has been offset, oh, a thousand or twelve hundred feet and dropped down probably a like amount by a crossfault. And how you can determine some of those things is by what you see underground in the Sutro Tunnel and elsewhere in the workings. That's one reason why it's important to map the underground workings.

Well, these gates that Sutro put in, they were still there when I was in there in the late '30's, and they were made out of redwood so

they wouldn't rot. (Of course, most all timber rots underground there due to the excessive heat and moisture.) These doors were about two feet thick. And so he figured the miners on the Comstock had to pay him so much a ton to take the waste out through the Sutro Tunnel and take the water out through there. And they fought him in the courts and otherwise to try to overcome this contract that he had with them. And he was afraid that, sometime, that they would try to loose large amounts of water to drown him out, and he decided if they did, he'd retreat beyond those doors and close them so they'd drown themselves as well. And then he had openings around the doors. He could open them up and let them drain out if it suited his fancy. He's a pretty wise old hombre, and he made himself a millionaire out of this tunnel.

Before we got to the Occidental lode, we also found the Sutro tuft on the hanging wall just east of the lode, and that's where we gave it its name, Sutro tuff. And it's also found on the surface around Silver City in the foot wall. So we can project it down to the vein on the foot wall and on the hanging wall, and by that means, get the displacement along the Occidental lode. And that's been checked up by Dr. Calkins of the Geological Survey. He checked me out on that and we were very much in agreement on the magnitude of that movement.

Well, that is the importance of going underground. And then, the students get to meet the miners, and they get to see the conditions under which the miners live and work. And they can talk to the miners and find out what they think about things, get their opinions, and they're usually quite outspoken, particularly if the boss isn't around, about how they like and don't like things, and how conditions are, and where they were from, etc. And, of course, they've traveled all over the country. So that was a wonderful opportunity, I think, not only for teachers, but also for the students, to be able to witness and this sort of thing.

Well, we don't have that any more because all of our nearby mines are shut down. And most of the big mines [that] operate in Nevada today—I said most of them—are surface mines, where they [use the] gloryhole method. They go and remove all the overlying waste, then mine the ore out by big earthmoving equipment.

You mentioned something about El Dorado Canyon in southern Nevada, south of Las Vegas, some of the mines around there. The El Dorado Canyon has been a mining district from a long, long way back, and it's possible that some of the old Mexican miners in the early 1800's were working down in there. Because there is a story I have heard—I think Professor Scrugham mentions this—of when the people were operating in El Dorado Canyon thirty, forty years ago, that a group of Mexicans came up the Colorado River and came into this canyon and made some inquiries because they had an old map showing the location of a mine that had been discovered and abandoned or lost for a prospect. (You know, it's not always mines. These lost mines may be just a piece of rock somebody picked up or a little prospect ore or a shovel hole or something. But they're called "lost mines," which is all right.) And these Mexicans came up there and discussed with these miners about this old lost mine, of which they had a map that had been worked on in ancient times. Now, how much truth there is to that, I do not know. Now, one of the old mines that was very productive in El Dorado Canyon was the Techatticup mine. And the Techatticup operated off and on for a long, long period of time, one of the most productive mines in that part of Nevada,

probably a longer working history than any of the mines at Searchlight, which is not far away. In fact, I was through Searchlight when those mines were running years and years ago, in 1916 or 1917.

Now, there was some talk about ancient mines in Nevada. It has been reported that Spaniards placer mined in Tule Canyon in the early 1800's. The only one that I know that is substantiated—the only ancient mine in Nevada—was the salt mines on Virgin River, near St. Thomas, which I mentioned earlier. They were operated by the Indians, and they were being operated by the Indians when Jedediah Smith came through there in 1826. And he wrote a letter back to General Clark, of Lewis and Clark fame, describing these mines. And a good deal was written about them in later times before they filled the present reservoir back up by Hoover Dam, Lake Mead, because it was going to flood the mines. Considerable was written about them because of that. In fact, one man said that it'd make the water so salty that it [would be] unfit to drink.But, of course, that didn't happen. I think they collapsed and covered up, and they didn't have enough salinity to amount to much, although I understand the water at Lake Mead is getting more saline than it used to be. And it'll get worse as they put more reservoirs upstream and cause evaporation [of] more water out of this river water.

Then there're probably other ancient mines in Nevada that we don't know about.I heard tell of old workings that were suspected of being Mexican or Indian workings, but we're not so sure of those. There are some ancient turquoise mine —surface mine—areas, shallow pits and the like, oh, some of considerable extent and fifteen or twenty feet deep, in San Bernardino or Kern County (I don't know which), and maybe forty, fifty miles west of the Nevada state line, where there was mining by Indians who used stone hammers and crude, primitive implements in extracting turquoise. And the Indians—the present day Indians, or the Indians of forty, fifty years ago—told men they were worked by some foreign tribe that came in there and took over, probably Aztecs. We don't know, but probably Mexican Indians. Or maybe New Mexico because they're very fond of turquoise. These mines are referred to briefly in a book on the minerals of California, published by the California Bureau of Mines. So if anybody's interested in those old mines, they could probably get more data from the references given there.

Now, of course, it's well known that the Indians traded sea shells from way up in British Columbia down off the desert here. Some long, slender shell—I forget the name of it, that they used as money. And then, the early missionaries in the 1600's, in New Mexico and Arizona and Sonora (especially Arizona and Sonora), they mentioned some blue shells that the Indians over there had, that the missionaries knew came from the Pacific Coast. And so they knew there was an interchange between the Indians there.

Well, now, something about some more of our mines in Nevada. The mines at Eureka were opened up way back in the '60's. They were very rich lead-silver mines, and they were operated largely by English capital. You'll find a good many typical English names still around the area there. And they smelted the ore in lead smelters that used charcoal for fuel. See, there was no known coal in Nevada or nearby in those days, no oil, of course, and petroleum. And so they burned pinion pine—practically deforested the hills for many miles around out there. And you can still go out to those hills and find a great deal of wood chopped down but not brought in. I have seen great masses of it just left where it was when

the mines closed down. Well, that wood was hauled into Eureka—that is, the wood was burned into charcoal and it was largely done by Italian workmen that the people called carboneros—charcoal burners.

Southeast of Ely, about fifteen miles or so, there's a whole series—a dozen or so—of beautiful charcoal kilns built out of cut stone, conical—well, sort of onion-shaped, domed kilns, something like the Turkish or Russian domes on the mosques, and so forth. There must be a dozen in there, and they're beautifully built. I don't know whether they're being preserved or not. There should be made a state monument of some sort. And then there's some more, a few down on the shores of Owens Lake, not nearly as spectacular. And there's about the same number (as east of Ely) and about as spectacular ones up in a branch of Grapevine Canyon in the Panamint mountain range west of Death Valley, on the road from Trona to Death Valley, right near the park summer headquarters. Oh, they're well worth seeing. And they were used for burning charcoal. Now, of course, those were for the local mines around there, and the kilns down at Mono Lake, I think, were for the mines over at Cerro Gordo (which means a fat hill," or "a plump hill"), where they mined a good deal of lead ore and silver east of Owens Lake, up in the Inyo Mountains. That's a nice trip, steep road. Terrific. Go up there sometime. But don't go over into Saline Valley unless you ask the sheriff where they've got all that spare water buried out there because they pick up about three people a year that've died of thirst in Saline Valley. So it's no place to go alone or short on water.

Now, let's get back to some of the mines. Well, these Eureka mines, they burned the charcoal to smelt the ore, and they had a narrow gauge railroad that ran from Eureka (and it was operating; I remember when it was operating), ran from there up to Palisade on the Southern Pacific. And in smelting the ore, they got out lead bullion in great quantity, rich in silver. And at one time, for a short period of time, the Eureka mines' production set the price on lead in the world markets. So at that time, it was a great lead and silver producer. They hauled the bullion up to Palisade and shipped it on the Southern Pacific railroad. And this narrow gauge road also hauled up there—during World War I, there was a great demand for arsenic for making poisonous gases they used in the world war—or rather prepared for its possible use. The arsenic was in the form of what's known as speiss, which is a combination of arsenic and sulfur and some other things. It's very hard and quite brittle, and it forms on the surface of the lead bullion, and when it's cold, these are pried off and thrown into the dump. But during World War I, they gathered up these for the sake of the arsenic. (You know, back about that time, they used to have smelters to smelt arsenic ore to produce arsenic. But nowadays, arsenic's such a drug on the market the Swedes melt it up and cast it into large blocks and take it out and sink it in the ocean, or they did—another pollution of the ocean.) But that arsenic, they shipped a lot of it. And then, when World War I stopped, for years and years, there was a great mass of speiss stacked around the depot at Palisade. Whether it is now or not, I don't know.

Eureka is in very interesting country. We took the field class on Hunt Foundation money and cars out there to spend the summer of '39 and did quite a little out there. It's so different than the geology in central Nevada. You know, there's a big change in it about at Austin. When you get east of Austin, you find a great lot of sediments. And then, in northern Nevada, they come a little farther to the west than Austin, and the rest of the

geology's utterly different than it is out in the east.

Now, Copper Basin and Copper Canyon were ofttimes worked together. They are now. Now, they were opened up in the '90's, I believe, and they had a company organized that was going to do great things. They did a lot of prospecting and development work there, and I guess they shipped some ore. They tried out the old flotation process that was invented, I believe, at Golconda, or south of Golconda—they called it "flotation"—and they had a big drum that went around and around, and the sulfide ores were spilled out on the surface of the water flowing gently through there. And the sulfides would float if they were oiled a little, and would float off and be concentrated. And they called that "oil flotation," an utterly different process than the flotation process used nowadays. And, of course, that was not an efficient method and went by the wayside. I can't think of that company now, but they owned these claims south of Battle Mountain. They were taken over in the late 'teens and early '20's by the Copper Canyon Mining Company. I worked for the company in the summer of 1920, summer and fall. At the time, they were doing considerable drilling to explore for more copper, and they stripped quite a tonnage of ore. And that company finally shut down in the latter part of the 1920's. The man who was the manager, his name was F. Sommer Schmidt.

Then, except for a few leasers working out through the area during a time of high copper prices, nothing much was done until just a few years ago when this new company took over, Duval Company, and took over both Copper Canyon and Copper Basin, and built some large mills down there for the concentration of the copper ores. Of course, they're operating on a large scale excavation and mining operation and large mills for concentration or leaching.

An interesting thing about Copper Canyon, there's [a thrust] similar to the large thrust fault, big Roberts Mountain thrust, that led to the discovery of Getchell—of the mine owned by Newmont, out north of Carlin. And also, the fault at Copper Basin, it comes around out of Copper Canyon near its mouth. Drill holes have gone down through that thrust and found some gold ore down below it. It's interesting now if this new company will take up some of those claims.

I know I examined some claims once, owned by an eastern university. They had some down in Washoe Valley and some out at Austin and some up at Copper Canyon, when I went out and looked them over to advise them whether they were worth holding or not. I was recommended for the job by the head of their geology department, under whom I had studied back in the '20's (this was in the '50's, I think). And the claim in Washoe Valley, I thought, was useless. They inherited these claims.

And they had some in Austin—to the west of Austin, western part of the district, that were high in suit ides, and they were called base metal veins. They were not the high grade silver veins that the town of Austin thrived on. I thought at the time that they didn't promise much. I don't know whether they do now or not. Maybe they're worth something; I don't know.

But I did tell them to hold on to the one in Copper Canyon because it was under that thrust fault where other gold ores had been found, and then there's considerable interest in these copper mines. And possibly, these copper mines would be taken over by a large company, and if they did, they'd probably want these surrounding claims. Now what happened further than that, I don't know.

Then I was employed at Copper Basin, I was doing sampling at times on the churn drilling, and I also did some surveying and geological mapping. And they had a man come out there from, I think it was the Massachusetts Institute of Technology, and I worked with him out there doing some mapping. We found a thrust fault—that is, I did—and I finally convinced him that it was a thrust fault. But that thrust was from the east and moved upward toward the west, as near as we could determine, and probably was local.The big thrust, the Roberts Mountain thrust, has an eastward movement to it. And we knew nothing about that fault at the time. That was discovered long after our work in Copper Basin. It was discovered in the Roberts Mountains in central Nevada, west of Eureka. That's from where it took its name.

Then this company I was working for there at Battle Mountain finally gave up. And now, as I mentioned before, it's being operated on a large scale. I also mentioned Copper Canyon. The ore up in Copper Canyon was somewhat different.

And by the way, there's a little place out there called Galena Canyon, I believe. In there, they had a lead mine, containing a lot of pyrite. And actually, the mine is full of caves. And these caves are different than most caves. They're not dissolved out of limestone, and they're not caves formed by lava that solidifies on the top and then the lava flows out from underneath. They're not that sort of a cave. But they're due to the solution and removal of pyrite, iron sulfide. And as it was removed by ground water, it just left big cavities in there where the pyrite had once been. It was mined out by ground water. And then, in the lower levels of that mine, when you get down level with the canyon, below that, there was a great deal of iron sulfate that had not been carried out—ferrous sulfate, commonly known as copperas, which is comparatively rare in mines (in large quantity). But there's large quantities in there. If you want any ferrous sulfate, there's a good place to go and get some. (That's known mineralogically as melanterite, and it comes from the Greek and Latin word melanos, meaning "black" or "dark." I believe, in Italy, they call the shoeblackers melaneros, because they blacken shoes. And that's where the word "melanterite" got its name, because, in the early days, they used this iron sulfate to blacken leather because leather was tanned in those days by tannin, largely from the tanbark oak, or other trees that produced tannin. And then you just washed the leather over with a little iron sulfate, and the iron combined with the tannin produced this black color, you know, like black ink. The U. S. Post Office used to make it (ink), largely iron tannate. And there's two streams in Africa, so they tell, where iron comes down one stream, and tannin from the oak forests in the other, and when they come together, the water turns dark, almost black, due to the producing of ink. When I was a youngster, [laughing] I worked for a harness maker. Dad used to hire harness makers, and he bought the leather white, undyed; it came out practically white, kind of a yellowish white, cream color. And then the leather was cut up and used to make our harness. So I learned a little about harness making and sewing with waxed thread, and that sort of thing, from this harness maker. One of them, this harness maker, I'll never forget his name; his name was Calameze, and I always wondered where that name, Calameze, came from. Sounded to me like an Arabic name, or a Turkish, or something. Anyway, when he first started to work and he knew I was going to help him—I was just a kid only eight or nine years old—he told me to get a gallon can and fill it about half full of water and fill it up with a lot of rusty

iron, iron nails and so forth. So I dug these up, and we let it stand there for two or three days, and then he took the water and painted it on the white leather to make it turn black, like shoe blacking. So that's been handed down from ancient times, I guess, about these shoeblackers, where we got the name "melanterite.")

And there's also that same mineral—if you're interested in going out there sometime, go up the east side of Pyramid Lake, past the pyramid. And up over a hump, there's a big, high hill with drainage coming around it from both sides, what they call circumferential drainage, or something like that. This big, high hill sticks up and there's a mine tunnel that runs into it. And there's a mine on top, an old mine that went down a hundred feet or so. And then down on the northwest slope, oh, maybe a couple hundred feet above the lake or so, there's some short tunnels go in there, and there's all this melanterite in there that came from the partial oxidation but not removal—well, they aren't highly oxidized because this is ferrous iron. And if you put it out into the air—it's white; it'll oxidize to a reddish color or a yellowish color. So that's of interest to see. Those aren't ancient mines, either. I remember some of them when they were put in there, some of the tunnels, but not the old mine. Now, let's see. That finishes up Copper Basin and Copper Canyon.

I might say something about the Elko oil shales. It's well known that in Wyoming and Utah, northwestern Colorado, there are huge amounts of what we call oil shale. Now, these oil shales do not contain oil, but they do contain hydrocarbons, which, under distillation—what they call destructive distillation, where the temperatures are run up to high temperatures, red heat, or practically red heat—these compounds'll come off in materials that are very similar to crude oil, petroleum, very similar to it. And there's been a great deal of study made on those shales in the hopes of someday producing oil. They contain billions and billions of barrels of petroleum which probably someday will be produced if the economics are such that it proves economical or necessary.

Now, we have in Nevada some shale similar to that, not nearly as extensive, nor so rich, in the hills just south to southwest of Elko. And they were mined at one time and considerable oil produced at a plant called the Catlin oil shale plant. And back in the early 1900's, I think it was, they mined the richest portion of those shales (I believe they're Eocene in age, the same age as the Green River shales), and for some years, they operated and produced oil and sold it, but evidently could not compete with ordinary petroleum, so they dismantled the plant, and it hasn't been operated since. But they did prove of considerable interest because of containing oil-bearing material.

And then, over the great Roberts Mountain thrust that I mentioned a while back, down in the Roberts Mountains, there's also a formation that contains oil shales. But whether they're rich enough to be worthwhile, I don't know. I doubt it. But they might be.

Also, in these shales at Elko, long before any mining was done over there, there was a collection made of fossils and leaves, et cetera, and I believe that was one of the earliest findings of the early sequoia that forty or fifty years later was found growing wild over in southwestern China, known as the "dawn redwood." But they found very similar fossil plants, too, in the shales at Elko. Of course, they find many, many places over in Nevada where they get the fossil remains

of a redwood similar to the Coast redwood, *Sequoia sempervirens*. That's widespread.

We also found some wood, nonpetrified wood, ten million years old. In the late '30's, there was a man in Reno operating an old Tertiary channel placer gold mine, up on Forest Hill Divide, up near Duncan Peak. And up there, in driving the tunnel in there to work these placer mines, they found a limb about a foot in diameter, a log lying across the top of the drift. And they chopped it out and threw it outside. And they brought a piece over to the University—or gave it to me and I put it in the University collection. It's probably up there yet. And it was of Pliocene age, so it probably is ten or twelve million years old. And it's wood; it's not petrified. You can whittle it and saw it and shape it and plane it, has no mineral matter in it.

And then in 1960, while they were cleaning off the canyon walls for the Frenchman reservoir dam up out of Sierra Valley, on Last Chance Creek—cleaning of f the hillside there, they ran across a—well, there was a depression that the bulldozer sank down in. And they dug this out to see what that was, and there was a hole going down into the ground, a hole about seven and a half feet in diameter. I measured it, perfectly circular. So they hired two miners, and they erected a headframe or a windlass and a hoist, and cleaned out this hole. And down at a depth of about forty feet, they found a piece of redwood about five feet in diameter and eight feet long. There the hole was seven feet across. So this hole had tapered about six inches in that forty feet. And on the way down, there were holes where limbs had extended out in the wall rock. And this proved to be redwood, like *sempervirens*. And you could run your hand in these holes and drag out pieces of bark, not petrified. And in some places, they found parts of this log that were petrified, and some of the log that was not. I got a piece of this wood (I still have a piece about three or four feet long) that came out of that hole. And the age of the rock that encloses this wood, the age has been determined by a radiometric method as being about eleven million years. And there's a piece on display up at the Oroville Dam, or used to be. I suppose it still is. And when they found that, then they bored down below that, dug down below it another eight or ten feet, the hole was still going, and they bored a hole down (augur hole) another twenty, thirty feet. And the hole was still going down.

So about eleven million years ago, this tree was upset there, probably by a volcanic explosion—blown over— and buried under the volcanic tuff and silt and—not silt, but ash—I guess there was some silt, too, because some leaves [were] buried in there, buried in the volcanic breccia. And so after excavating this hole, they filled the whole thing up with concrete. And then they bored more holes, much deeper than they had before, because they expected these—didn't know how deep this would go, and they didn't want any holes of where the trees are rotted out and left holes under the dam for the water to flow through. But they fortunately didn't find any more. But they did find some more nonpetrified wood of that same age way down deep, under where the big dam is now, up at that lake.

One of my former students, a man that took geology from me in class, who was a civil engineer, was working up there, called my attention to it. So I went up there and got some of this wood. And they were going to rush it down to Sacramento to determine the age by radioactive methods on wood for Carbon 14. But, of course, that doesn't go back more than about 40,000 years. I thought their men knew that, but they didn't. And their chief geologist from Sacramento called me up and asked me about it, and I told him it wouldn't work out.

They'd better get their radiometric dating on biotite or hornblende or some minerals in the volcanic breccia, which was done, and they found [it was] about eleven million years [old]. Well, so much for petrified wood and oil shales.

Now, the oil in Railroad Valley. The oil in Railroad Valley, Nevada was discovered in a well not far from the Quinn Canyon range. Quinn Canyon range lies along the east side of Railroad Valley. See, in the early days, they named a lot of these valleys because of the great interest in running railroads from east to west, and whenever they found a valley that looked like it would run a railroad right straight through with hardly any grading at all, they'd call it Railroad Valley. And when they found a lower pass, like the one between oh, Reese River Valley and the valley to the west, there's a low pass, they called that Railroad Pass. So we have quite a few "Railroad Passes" and "Railroad Valleys" throughout the country, and they do not have railroads in them.

So Shell Oil discovered in the '50's this oil in Railroad Valley and set of f a great oil boom all over Nevada, and especially eastern Nevada. And so, another company came in later and drilled a well right near Quinn Canyon range, which most people thought was so close to the range that they would go down through the valley fill and through the fault into the old rocks without discovering any oil. But evidently, those faults along that mountain flood are much steeper than they are normally, because they did bring in oil right up near the mountain front, and they didn't go through the fault. And the oil was found in a series of volcanic tuffs and volcanic sediments. But in the limestone below this valley fill, there is some old, dead oil—nonmoving oil products—in the limestone below that, Permian limestone. And so a good many geologists are of the opinion it came out of that Permian limestone. It's a very unusual oil, however, in that it has a paraffin base; in other words, it's very high in paraffin instead of being high in asphalt.

Paraffin oils are very rare in the West. They do get some in southern California, and they get considerable in Pennsylvania. Of course, most of their oil's a paraffin base. And they get some in Oklahoma, although most of Oklahoma oil, I believe is not paraffin base. So, that makes their oils quite interesting because of that paraffin. And they have to keep it at a high temperature in order to ship it because it'll congeal.

So they ship it hot [from Railroad Valley] in heated trucks, insulated trucks, over to Salt Lake City to the refinery. And there's been quite a little production. About a million barrels have been produced there up to the present time.

They may find more oil in Nevada yet. We don't know. There's a lot of reports of oil seeps over the state, but most of those were merely organic material or films of iron compound floating on the surface of still water or organic material that looks like an oil film that's not oil.

Now, we might say something of the mining at Hamilton, Nevada. Hamilton is in the White Pine mountains. They call them the White Pine because of the pine trees there; they're determined as "white pine." There's quite a little forest in there up in the mountains. This district was discovered in the '60's, I believe, shortly after Eureka was discovered. And they found outcrops of a very rich silver ore, mostly silver chloride. They call it cerargyrite; it comes from the word *cerus*, meaning "horn," and *argentum*, meaning "silver," because it's made out of silver chloride, and it looks something like horn, has about the luster and translucency

of horn. So the miners ofttimes called it "horn silver." What the name really means, Cerargyrite, is horn silver, of course, or wax. That word is used also for waxy compounds, you know. They had one piece that weighed six tons, or 12,000 pounds—one solid mass of cerargyrite, which they had to cut up with chisels to take it out of the mine. And they had quite a number of smaller masses. And where'd that all come from? Where'd all the salt come from that turned that silver into silver chloride?

Well, lower down, they had silver sulfides in the mine, though the ore extended down but a few hundred feet. So higher up, those would oxidize, and the silver would be liberated, probably as silver sulfate. And then it would react with chlorine to form silver chloride, which is a highly insoluble compound (most people call it insoluble). But just think of all the tons of chlorine it took to convert the silver over to tons of silver chloride. And, of course, there probably were many, many tons of salt passing over the top of that (that's where the chlorine came from —sodium chloride), blowing off of the salt desert, blowing eastward up over that mountain. So there must've been thousands and thousands of tons of salt before this oxidation took place. And then there was thousands and thousands of tons have gone over there since all the silver that was available was converted to silver chloride. And then, of course, for miles and miles, there was sodium chloride f lowing over the country.

So it shows a great eastward migration of salt. I say eastward because we know nowadays that salt migrates eastward from our prevailing west winds. And it migrates southward from our north winds. And it goes eastward off of the Great Salt Lake into Ogden, Utah. They get some very violent salt storms there at times. We've had some salt storms in Reno, or rain or sleet rich in salt. A great many of our salt deposits in Nevada show that they have moved eastward from their original sites, and some are moving eastward now, like the salt from around Lovelock blows over the mountains, and I have been told you can taste it in the dust over around Elko, and so forth. So we have an eastward migration of salt. Oh, yes. And that's common throughout the Great Basin. And I don't mean just out in the flats. mean the Great Basin which extends way up to the extent of its hydrographic basin or watershed.

Now we got way off of Hamilton, haven't we? Well, anyway, at Hamilton, a man who was working out there once when I was out there with the students, he said he always carried (and he did) a big automatic pistol on his hip in case he'd meet [mountain] lions underground. Well, I think probably you're better off if you just let the lion jump over. You drop down and he'll either jump over or run out. All he wants to do is escape.If you corner them, then they get savage. I know, from cornering bobcats underground. They get to be real nasty animals. But there are a lot of [mountain] lions out there.

I know I had an experience.I had a class out one day west of Hamilton, and I can't think of the name of that hill now. Oh, yes, they have a ridge out there known as Pogonip Ridge. And that's where the name "pogonip" originated and became very much fixed in the language of Nevada. We have pogonip fogs, you know. And the Fortieth Parallel Survey were making a survey of the White Pine district (this was back in the '70's), and one day, there was a heavy, white fog like we get, crystalizing out on every twig and around it with the frost precipitating on it. And the Indians were very much frightened about it, and they went back into their wickiups and caves, and so forth, and were very much

disturbed over this white fog. And the survey man asked them, well, what was wrong about this fog? And they called it the "pogonip" or "death frost," because they claimed it killed people, and it probably did. Because those ice crystals, if you breathe them into your lungs, they could perforate the lungs and probably lead to pneumonia or some pulmonary ailment that would carry them off. And they called it the pogonip. And that's where Pogonip Ridge got its name, and also our pogonip fogs and frosts.

Well, we were down to a copper district, a contact copper deposit, along the valley and in the mountains to the west of Hamilton. And we walked up into the hills there and coming down, I had lost my Brunton compass. So I went back after it. The strap on it broke and it dropped off my belt. And I walked up the trail and found it and then came down the shortcuts we'd taken. And when I came down, I found that big lion tracks had followed us down when we came down. And I suppose as I went up, and he hid some place and let me get by, then he followed me back down again. Because when I went up after my compass, I found his tracks and our tracks. Of course, he wouldn't hurt us, but you know, it kind of gives you a thrill to think that you were being trailed by a big savage animal. It probably wasn't very savage, but they have a great curiosity. So this man carrying the big revolver probably wasn't such a dreamer after all, because we found out that there were many lions out there. At least, we found their tracks, which was pretty good evidence of there having been lions recently, being as the lion tracks stepped into our tracks. But that's the common thing, for lions to trail people around. So if you're out in a lion country, it might be a good trick to walk down a hill like that in the late evening and then if you can sneak around on the leeward side of the trail and get a picture of him coming down after you—.

So Hamilton produced a great deal of silver. And it's become a very famous camp from the geology. There's a lot of the early Ordovician marine sediments—not only Ordovician, but Paleozoic sediments from the Cambrain on up— are exposed there in the White Pine mountains, and it's quite a fossiliferous area. It also got a great deal of notoriety because there was an oil well sunk in the '20's, off to the east of there, where they claimed to have found some oil or gas in the wells. We thought it was mostly hot air. But they were drilling on a favorable-looking oil structure. And a well was sunk in the '50's to the west of there, south and west, down near Bull Creek, or Green Springs, where they claimed they did strike some oil in the well, although the well didn't become productive. Now, Hamilton. I guess that's enough for Hamilton.

Now, Delamar, Nevada was an old district of interest, a silver-gold producing district to the west of Caliente. And as you go on the highway leading out toward Delamar, you find a lot of rounded rocks weathered out of lava rocks. And these are practically, nearly, perfectly round, a good deal like the spheroidally-weathered boulders out of granite. Until I saw those, I thought that it was only granitic rocks that produced such big, rounded boulders. But these were in a lava rock, probably Tertiary lava.

Well, at Delamar, there was a man named [J. R.] Delamar [who] established a camp. In fact, there was a Delamar, Idaho, Delamar, Nevada, and Delamar, I think in Montana—all mining camps established by the same man, Delamar. I believe he's a Frenchman. And he mined over extensive areas. One thing about Delamar, the silica dust produced by dry drilling there was very bad.It led to

miner's consumption, or the silting up of their lungs with silica, cut the lungs and inflamed them, and they died of a disease from that. Tonopah was bad that way, but Delamar was probably the worst. And for that reason, miners soon named the stopers —I told you— air drill called a stoper, used in stopes largely, for the drilling up upward holes. One make was called a Waugh stoper, and there were other makes afterward, Ingersoll-Rand, and I don't know who all else, Denver Machinery, and so forth, made these stoping machines. And most of them operated in the early days without water. Nowadays, they operate on water to cause the dust to run of f as a mud and not fill the air with dust for miners to inhale. And because of these stopers making so much dust— and in mines like Tonopah and Delamar—and giving miners this disease of the lungs, they were referred to by the miners as "widow makers." So when you spoke of a "widow maker," it meant a stoper, stoping machine.

An odd thing at Delamar, and one of the most curious things I ever knew about, the deposition of gold and silver, and gold, particularly. They established a cyanide plant there, where the gold is extracted by being dissolved in cyanide, then precipitated on zinc dust. And there's always a certain amount of values (gold and silver) that escapes in the tailings, and a certain amount of cyanide, also, although there the tailings are washed thoroughly to get out most of the dissolved metals. And, of course, some of them may not be dissolved, but in time the cyanide ultimately dissolves them. So that at Tonopah and other places, there were men who used to go out to these levelled old tailings ponds, and they'd take a broom—whisk broom and other brooms—and sweep up the dust off the surface every month or so and sack it up and ship it to the smelter, because that surface dust was very rich. The cyanide still left in the tailings would come up to the surface as an efflorescent, just like you see alkali out in the desert. And that would draw the salts up out of the tailings, and with it'd be the gold and silver dissolved and evaporated on the surface. They'd sweep up the dust, then that was shipped to the smelter. It was high grade material.

Well, there's an odd thing happened at Delamar, and I had some of the material to show for it. And that was that there was a stable down in a canyon below the tailings pond, and every once in a while, some of the water would seep down from the tailings pond and would flood this stable in part. And out alongside the stable were large stacks of manure from the horses that they kept in there. That was the days when horses were used so much for power and teaming and all. And the cyanide, as soon as it came down there, it was absorbed up through the manure and evaporated. And in the manure, there was a precipitation of sulfides—iron sulfides, looked like pyrite, there might've been others, too—but they were saturated with gold and silver. And I knew the men that burned this fertilizer on sheets of iron and shipped the ashes to the smelter because it was quite rich in gold and silver. That's one of the few cases I know of pyrite being precipitated in material that was above ground.

I did see antimony sulfide, stibnite, precipitated on the surface of the water in some of the pools down at Steamboat Springs. And in clinging to the rock—and that has been seen not only by me and Professor Jones, but by later geologists—showing that this sulfide was precipitated at or near the air surface, air-water surface. And, of course, at Steamboat, I have seen the water there just all turn silvery from the finely divided stibnite floating up in the water— probably not

precipitating at the time, but had precipitated down below and then was sluiced upward on a violent flow of water.

But that thing at Delamar always fascinated me to think of the reprecipitation of the sulfides and of the gold and silver in organic material. So it shows organic material probably has a great deal to do with some of our shallow ore forming processes, and particularly, I thought some of the near-surface enrichment—secondary enrichment—out on the desert was probably due, in part, to the solution of organic material in the outcrops of veins and carried down by water. It probably formed a solvent or a precipitating agent in the process of secondary deposition.

We know that up here in the old Tertiary gravel deposits that there were deposits of pyrite, or a sulfide that looked like pyrite, precipitated in the bottom of those channels, flooded by water, where the oxygen didn't reach, and was probably precipitated by organic material in shines and vegetation—leaves, trees, portions of wood—that were buried under there. And then when those same gravels were later exposed to percolating surface waters containing a lot of oxygen, these gravels, instead of being dark-colored, or what they call "blue gravels," would change to yellow and red gravels due to the oxidation of the iron sulfide—you know, it oxidized over to hydrous iron oxides—limonite, hematite, and so forth—or hydrohematite, probably.

Now, Pioche was discovered in the early days by Indians. A town nearby, Panaca, got its name from the Indian word for silver, or silver chloride. Pioche got its name by a mining man by [the] name of Pioche. (And his initials were F. L. A. P. So I suppose the boys always called him "Flap" when they were on good terms with him.) Pioche is now just about gone kaput because the mines have played out, or at least they have been discontinued, [don't] operate at the present time—or the last I heard of them. They have one of the most expensive courthouses in the whole western country. You've probably heard that tale. They also had a reputation of a lot of men being killed there, like the "bad man from Bodie that just came to town."

We had a drunk [near Honcut] that used to sing that; that's about as far as he got: "I'm a bad man from Bodie, and I've just come to town." And he's sing that pretty near every Sunday when he came home drunk. And one day, I found him lying down by the road in the hot sun, and he was just as red as a beet from sunburn, you know. And I rushed in and told my dad that one of the men was out there, and I thought he was dead. So Father went out and looked at him, said he wasn't dead, but he certainly was well parboiled by the sun. My father said he had a sun stroke, although he, of course, knew the man was dead drunk. I didn't know what else was wrong with him, but apparently, he was not sober by a long shot. So they dragged him into the bunkhouse and put him on a bed, and he came out of it all right. But that was the wild "man from Bodie."

Pioche produced a lot of silver ore from the rich ores near the surface, and then they finally became a lead-zinc producer largely, although they produced a great deal of silver. But near the outcrop, during oxidation and leaching, much of the silver remained behind. The lead and zinc were dissolved and went downward. Now, a lot of the lead would stay behind, too, you know, as lead carbonate. And it also forms a lead sulfate (which is practically insoluble) and lead carbonate (which is practically insoluble). But silver sulfate is quite soluble, and it'll migrate with the surface waters, ground waters, unless it's changed over to one of the halogen group, like chloride, iodine, or bromide. By the way, they had all of those minerals at Wonder, Nevada.

They had silver chloride and silver iodine and silver bromide. But, of course, the chloride's the most common of the three of them. And they were called the halogen salts of silver from the Greek word meaning salt.

So Pioche was discovered, and Panaca, from the rich silver ores. Panaca didn't have any rich mines, but Pioche did. And at the time it was discovered, the nearest railroad was the Southern Pacific or the Central Pacific way up in northern Nevada. So they used to run freight teams from about Palisade and through Eureka and on south to Pioche—oh, two hundred miles or more (you'd have to check that up on a road map), and they had bull teams. So we have a place out there called Bull Hill and Bull Summit, and so forth, because of these large ox teams that hauled freight from the Central Pacific railroad on down to Pioche. Now, Pioche finally got a railroad nearby when the Union Pacific came through Caliente and Las Vegas along about 1908, '09, along in there. Before that, southeastern Nevada was a very, very difficult country to reach. Most people of the present time have no idea how isolated that region was. Then a railroad was run from Caliente up through Panaca to within a few miles of Pioche, and another one went up on around the Ely range and down the west side to the mines across to the west of Pioche.

I might tell you of another—this isn't mining; this is oil, but it might be of interest to put this down. It's a rather unusual thing. There was a cattle buyer by the name of Peasley. I've forgotten his first name now. Of course, this happened a long, long time ago. I had seen Mr. Peasley when he used to buy cattle for some meat company that operated out of Nevada City, California, and they sold meat all over the country. And, of course, that's out now. They couldn't compete now with Sacramento, et cetera. But in those days, they were large operators.

Mr. Peasley went up to the Little Truckee river, drove up there with a horse and buggy from Nevada City, to hunt sagehen. That was a great sagehen country in the early days. As you probably know, there's a creek nearby called sagehen Creek. There're very few sagehen there now; they're just about killed off. And while he was hunting sagehen, some of them flew into the trees, and he thought he'd killed one in there with a shot. And he went into these willows along this little creek, and he stepped into oil up over his shoetops. And he was very much astonished, naturally. (This was in the '90's, by the way, about 1894 or '95, along in there.) As a matter of fact, it has something to do with mining, too. That's what reminded me of it. So he took a sample of the oil and got a bottleful of it and took it back to Nevada City, gave it to a banker there, and they got all excited about this oil. They had a sample of it analyzed, and they found out it was paraffin grade oil.

Now, at that time, very little oil had been found in California, and certainly no paraffin-base oil. There had been none found in the Midwest at that time, either. The only paraffin-base oil that was then known, so far as I know, at that time, was Pennsylvania oil. And so they thought, now, here they had a wonderful thing because they had paraffin-bas oil unknown in the West and [it] stirred up quite a little excitement, then it died down.

Well, then, in 1919, my brother came to me with this story (that's where I first heard of it), and so we went over to the Little Truckee to see this oil deposit. I told my brother I didn't think there was any oil over there because, as I remembered the geology, it was all granite country, overlain by not very thick deposits of very porous Tertiary volcanic breccia and tuff. But he thought it had possibilities. And, in fact, he had gone down to San Francisco one time and got one of the big oil companies

(I forget which one) interested in investigating it, and they sent a geologist up there, because my brother told them then that if it wasn't exactly as he represented it, that he would pay all their expenses. So they sent a geologist up there, although they didn't expect there'd be much oil up in that country, either. But he reached the same conclusion that I did, that there wasn't any chance of oil in that area. But where the oil came from was a mystery.

Well, it so happened that the thought occurred to me and made it very easy to solve some of the problem about the oil. I told my brother it looked to me like—well, first, the road that ran through there at that time was an unimproved road, just out through a meadow, came down a hill into the meadow and across the meadow, probably a mile and a half, or two miles across, and up a very steep grade up to Webber Lake. This oil that Peasley had found (and we found remnants of it there) was right at the foot of that steep grade. This was near the willows along the stream where Mr. Peasley saw the oil. And the other deposit was out in the center of the valley near a deep gulch. And I could see from examining that oil and digging at it, it didn't seem to go down any place, seemed to be only about a foot deep. It was but residual material left after the evaporation and absorption of the lighter fractions. And so I figured it'd been spilled on the surface, did not rise from below. And then there were some globs of oil along the road going out of the valley and on this steep hill coming down into the valley on the eastern side (not where the liquid oil was found, but on the eastern side). There were some blobs of oil along the center of the road going up that hill. And there was no liquid oil left anywhere.

So I reasoned that if there had been an oil seep there that there still should be some fresh oil coming out of the seep, and there wasn't any, and from that and from the distribution of the oil and all (and it was all parallel to the road or on the road), that somebody had hauled some oil in there. And so I pictured it this way, that somebody had come in with oil, and they had dumped some in the middle of the valley. That they were probably in there in the wintertime and there was mud and there was soft ground and muddy road, they'd've spilled some of the oil out of one of the tanks out in the middle of the valley. They tried to pull up that steep grade on the west side of the valley, and they couldn't get up the grade; they got stuck. So they opened the tanks and dumped the oil, which ran down into the willows along this little creek (and that's where Peasley found it). And then when they came back and started up the hill going out of the valley again, they stopped there to let their team get rested, "blow," as we called it. Now, if you didn't know anything about horses and teams, these things wouldn't occur to one. But I know when horses have been pulling through heavy mud and they've started up a steep hill, you have to stop and let them breathe again 'til they get their breath, or second wind, as we called it.

Well, my brother thought that was a very good "theory," all that sort of thing. But he considered me quite a theoretical man, which I suppose I was, or am. He wasn't a bit satisfied with my interpretation. He finally came in to see me, though, a few years after that. And he had found out how that oil had come to be there, himself. He found some old timers that ran sheep up in that country. You see, he was trying to get a lease on this ground to, again, get somebody interested in the oil possibilities. And while he was trying to get these leases, he ran across a man who owned property there. And, "Oh," he said, "I can tell you how the oil got there. Oh, I can tell you who the man was that hauled the oil in there!" He said, "You remember years and

years back, there was a mining development up at Summit Lake." (Now, there's a whole book written about Summit Lake [that] came out recently. Maybe you've seen it. And he has a very good story—well, he makes a big story out of a very minor affair, I thought. So the book didn't turn out to be much of a book. But had he added this to it—which was related to Summit Lake—it would've made the book much more interesting. I think I'll have to write this up myself someday and publish it in some magazine.)

And here's the way it came about. They have some mines up at Summit Lake, northeast of Old Man Mountain, and those mines at Summit Lake were discovered back in the '70's, I believe. There were quite a few people from the Comstock Lode [who] came over there to look them over, together with a famous news writer on the Comstock. What is his name? Wright? William Wright, pseudonym of Dan DeQuille. Dan DeQuille was over there, and quite a few others. And the Summit Lake strike was a great excitement for several years. They built a great many buildings there and hauled freight up or packed it in on pack animals. They hauled some in by wagons, I believe. I don't know where the nearest rail paint was to Meadow Lake. They used to come up from Nevada City and Graniteville and in that way. The nearest railroad was the Southern Pacific, but whether they had it—I believe they did have a trail in, yes. There was a trail, a pack trail went from Cisco up Rattlesnake Creek and on up to Meadow Lake, which is near Fordice Lake, and they had this big town, quite a large town there (that is large for the time), and the activity only lasted for a very few years. But anyway, they had gold ore that was difficult to treat and was not economically feasible. But they reached the conclusion that the operation was not economical, not because of the low grade ore, but because the values were difficult to extract. And they had all kinds of theories about treatment of the ore and of gold that you couldn't detect by fire assay, and we (technical men) don't know of any such gold. Nobody has ever found or proven any such thing. They thought they had a great deal of gold in the ore and that the metallurgy wasn't right to extract it. There have been recurring attempts to mine, and treat this so-called ore.

As it turns out, however, so far as I know, they were very, comparatively, low grade veins, and they didn't contain much gold. That was their main difficulty. But there had been discovered, that along in the early '90's, in Denver, Colorado, a woman was washing some ore bags, sample bags, that were quite greasy, and in washing them out, she found that the grease coagulated the sulfides of the ore, and her husband jumped on that and developed what he called the oil flotation process. In other words, you coagulate the sulfides with oil, and then, by putting it into a cylinder, or rotating this, you could spill the oiled sulfides out upon the surface of the water and it would float off and could be skimmed off, and thereby, get a concentration of the sulfides. And that process—I don't recall the name of it now, but it was used at one time over south of Golconda, Nevada, to concentrate those ores over there. But it didn't turn out to be a very successful flotation process. The present-day flotation process operates on an entirely different principle, where bubbles of gas attach themselves to the ore, and the ore floats to the surface and is thereby skimmed off. It has proved to be a very successful process.

Now, it was because of this new discovery that there was new interest at Meadow Lake. They figured if they could bring crude oil in there, they could use this newly-discovered process for concentrating their ore. So they

shipped some oil from Pennsylvania, paraffin-base oil from Pennsylvania, came out to Boca, California, on the Southern Pacific. It was shipped on the narrow gauge road from Boca to Loyalton. And from Loyalton, it was contracted with a teamster to haul this oil in to Meadow Lake. Now, this was very late in the fall, along in October or November. And the teamster told them that he would take the contract, but he'd want to be paid to haul the oil in there whether he got through or not because the chances were very good that he'd get caught in a storm. And if he got caught in a storm, he would want to dump the oil and bring his wagons out because he didn't want to leave his wagons up in the mountains under the snow all winter long because they'd warp out of shape and the wagons'd be ruined. So he did just what I told my brother, I could see what he did. He dumped some oil in the middle, and he dumped some on the hill as he tried to pull out of the meadow land. And then when he got his wagons together to start up the other side, he stopped for his horses to take a blow, and that accounts for the oil in the road on the hill going out of the valley.

I worked at a mine development out at Grantsville, Nevada, at one time. Grantsville is in the range west of Reese River Valley and about seventy-five miles south of Austin, the county seat of Lander County, named after General [Frederick West] Lander. (I'll tell you something about Lander. You know, Lander, when he was a colonel, laid out the road, emigrant road, across Nevada and through Winnemucca and west of Winnemucca by the way of Rabbit Hole Springs. And they made a spring; they dug out a spring at Rabbit Hole, made quite a large cistern, underground, rocked it up, and they dug out another one on the emigrant trail near Willow Spring or Antelope Spring. Now, where that spring is, I don't know. In the summer of 1970, I with Professor E. Richard Larson, studied the stopping places along the route and now are satisfied that we have the route and springs well determined. Willow Springs, on present maps is Antelope Spring of the emigrants. Big Antelope, a mile or more to the northwest, has been discovered and named at a later time. Well, so much for Lander.)

Well, this mine south of Austin was near Grantsville on the western slope of the Shoshone mountains. It was discovered in the '60's and I presume got its name from General Grant. And so we have Grantsville and Mt. Grant. We have two Mt. Grants in Nevada—got the one down in the Wassuk Range near the south end of Walker Lake, and the other one is up in the Clan Alpine Range to the east of Dixie Valley. Grantsville, at one time, was quite a lead producer—lead, silver, zinc, and some gold. I saw the largest sagehen rooster out there that I've (if they have sagehen roosters) —the tallest one I [laughing]—I have ever seen. He must have stood, oh, two feet high, looked like a turkey—a huge bird.

Anyway, I worked at Grantsville in the early '20's, and they had a flotation mill operating there. And they had the forerunner of the diesel engines (semidiesel, they call them nowadays, or "hot head" engine), and they drove our mill and flotation cells. It was not a very successful operation. It was operated in the early days with dry stamp mills. They were short on water, and a lot of the milling was done in dry form during the '60's and '70's. And the mills, of course, were very, very dusty, and the extraction wasn't too good. It was rather low.

Then above there to the north, was another town named Union that produced quite a bit of ore at the same time. And further up from that was—oh, near where the dinosaurs were found—Ichthyosaurs, rather, near Ichthyosaur Park. It was Berlin.

They mined at Berlin in the early days. That was a gold mine.

The vein at Berlin was a very unusual one. They had a series of faults parallel to the front of the range.(You know, most of our Nevada ranges do have faults along them, comparatively young faults. And the ranges have been uplifted and the valleys downdropped along those faults.) And the veins at Berlin were sliced with faults—well, I might state first, the vein had a strike or a trend parallel to the range front, and it dipped or inclined downward, under the mountains—toward and below the mountains. And therefore, the north-south fault along the front of the range had a series of parallel faults that sliced the vein into segments. And so when they went down an incline shaft to work the vein, they would strike a fault; they would go up on the fault and catch the vein going down into the mountain. And these faults they encountered, I don't know, but there were a great quantity of them. This was described, also, in the *Mining and Scientific Press*. It's called "The Berlin Mine."

Now, it was in this vicinity where the Ichthyosaurs were discovered. They were discovered by Ferguson and Muller way, way back, but they didn't call many people's attention to them for the fear that they would be vandalized. And Mrs. Wheat, Peggy Wheat, she found these, or learned about them at one time, and tried to get people interested in it and couldn't. And she finally went out there with a whisk broom and very carefully cleaned them up so she could get some photographs of them, and finally got Professor [Charles] Camp from the University of California. So Professor Camp, who's a very noted vertebrate paleontologist, and also quite an authority on early western history (probably more widely known for his history, although he's a world famous vertebrate paleontologist), Mr. Camp came out there, and he spent several seasons removing the rock from around these Ichthyosaurs and described them.

He told me that it was a very interesting thing in finding those because these are huge. They're among the largest, or some of the largest, that've ever been discovered. They're in Triassic limestones (that's the Shoshone range, by the way). They're as large or larger than any that were ever found before, and that was the startling thing about it. Because previous to this time, all the Ichthyosaurs that they had found gradually decreased an size with time. And so they were astounded to find these huge ones, much younger geologically than the older ones that were decreasing in size. And that these were so big was quite a discovery. And they evidently were killed—oh, I don't know what killed them. It's hard to say. No one knows. But they probably drifted into an embayment. And that's why we have so many at this one place. Now, these limestones also contain ammonites and other fossils. So it's a noted fossil locality in addition to the Ichthyosaurs.

Now, up the range from Berlin, oh, I don't know, six, seven, eight miles, in a little town [of lone], I paid fifty cents a gallon for gas out there when it was ten cents anywhere else. lone is just a little place with—I don't know how many people live there now. At the time I was out there, probably a half a dozen or so. And a man kept a store. I don't know when I was first in lone, I suppose in the early '20's.

Up above Ione, up the canyon, was a mercury mine, quicksilver mine. And it was quite a noted mine way back, called the—Nevada Quicksilver Company operated it. And at one time, it was one of *the* large quicksilver producers in the United States. (Of course, the biggest quicksilver producer in the U. S. was at New Almaden in the Coast Ranges of California down here, and I guess

another large one, too, was New Idria, farther south, and then, of course, there were a good many others. There's some in Nevada, too, that probably outproduced the one at lone. But at the time, it was the largest one.)

I might say that above Grantsville, up the canyon a ways, was the old Grantsville brewery. And at the time I was there, it was a wreck, but the building was still standing, and in it were quite a number of five-gallon kegs with "Grantsville, Nevada" burned into the head of the barrel, head of the keg. I wish now I'd saved some of those.

And another interesting thing, that over in the upper part of Reese River Valley, we used to go over to a ranch there and buy rhubarb. Now, this rhubarb was growing at an elevation of, oh, I would judge around 7,000 feet. And when you cut of f the stalks and trimmed the leaf off, they were just long enough to stick out of a barley sack. So, you can see, they were huge. I didn't know that rhubarb grew that large 'til I saw that.

Oh, before I get off of that area, too, down south of there a short distance, south and west of there, in the Paradise range was a spring known as Coyote Holes. During the time of the earthquake at Nina, on December 20, 1932, there was a prospector living up there, and he felt this terrific commotion, and he ran outside. And after the earthquake was over, he came back and lit a lamp. And somehow, he looked in a mirror and found that he was black as coal. He'd heard of a lot of people turning snow white from fright, and here, he thought he'd gone in the reverse direction, 'til he found out his face was covered with soot. Well, that's near Coyote Holes.

And below there a ways, a short distance, was a place called Pactolus. And there was a signboard there, carved that way, and I wished I had gotten it, because there was no Pactolus when I was there. It was just an intersection of two faint desert roads that were rarely traveled. And I thought it was quite interesting because Pactolus happens to be the name of a river in southwestern Turkey [which] empties into the Mediterranean near Smryna. Now, Smyrna' s not called Smyrna any more, and the river's not called Pactolus any more. But that stream is supposed to be the one from which King Solomon's supposed to've gotten a great deal of his gold, from this famous river, Pactolus. As I told you before, it's not called Pactolus now, and I can't think of the name of it. But it's in southwestern Turkey. And there's no river in this portion of Nevada like the river in Turkey. And there isn't that much gold there, either.

Oh, by the way, off to the southwest of there, up in the mountains, just to the east of Gabbs, were some pegmatite dikes that were operated on at one time for something or other. And they contained some scheelite, a tungsten mineral, and also hubnerite. As a matter of fact, that's one of the earliest minerals that was named and described from the first occurrence, being found in Nevada. It was called hubnerite; it was named after a man in San Francisco by the name of Hubner. And it's misspelled in mineralogy books because they thought it came from the German man [by the] name of Hübner, and so they ofttimes spelled it Huebner. But it was not. It was named H-u-b-n-e-r-a-t-e. And believe it or not, the first description of that mineral occurred, was published in the *Reese River Reveille*, I think in 1865, somewhere about that time.

Analysis of Ore Samples

In going back over the records of the Nevada Mining Laboratory, as it was called [I found that] it had been in operation since the early 1890's. I found that there was a

specimen of piedmontite that was sent in from Elko, Nevada. Now, I don't know of any piedmontite around Elko, and there might well be. And if there is, that was the first mention of piedmontite in the state of Nevada. There was none found in the state until along in the '30's, when we found some up north of Reno, a very fine occurrence of this red epidotelike mineral which was rich in manganese rather than iron. And since then, we have found some up in southern Oregon, north of Denio, in the—. I should remember all the mountain ranges in the state of Nevada. It is the Pueblo Range. I don't know if it's been found anywhere else, so far as I know. And there were other rare minerals. Of course, some were sent in, oh, I don't know why, just to find out if we knew anything, I guess. I'll tell you some of those incidents, like sending in the dynamite and also the dried up potato thinking it might be lithographic limestone, and sending in the green uvarovite garnet, chrome garnet, and piedmontite, again, before anybody discovered it in Nevada.

[Laughing] The prospectors used to send us in a lot of rocks to be examined. I'll tell you about one, about a tungsten deposit we discovered. Then I'll tell you about some others.

One time, by panning—or by close examination of ores —that I recall was an ore that came in to the School of Mines while I was teaching there. And Professor [Walter] Palmer, who was a very good man on recognition of ore-bearing minerals—I don't think there's anybody in the country that could do a better job than he did. But this ore came in, and it had a green mineral in it, a silicate mineral. So Walter called me in to ask me what the green mineral was. And I looked it over, and ran some optical tests on it and finally told him it was beryl. And it had no commercial value because it occurred in too small quantities in the ore. However, in looking at the rock, I thought it had a peculiar luster from a pegmatite, and I thought it might contain scheelite (the calcium tungstate again) - So we tested it out with the ultraviolet light, and it glowed beautifully. So we told these men that they had a deposit of scheelite that may be worthwhile, but the green mineral was worthless. Within a few weeks, they sold their deposit for several thousand dollars to the Nevada-Massachusetts Company, of which Ott Heizer was general manager.

And [laughing] an odd thing happened years later than that. I was out to a mercury deposit near Lovelock and after I had been there quite a while, one of the men working there came up to me and says, "And you're from the School of Mines, aren't you?"

And I said, "Yes."

"Well," he said, "they make a lot of mistakes down there.

"Oh," I said, "they do?"

And he said, "Yes, they do."

And I said, "Well, you know, anybody that really does much of anything in this world is bound to make some mistakes. And probably the worst mistake anybody could make is not to do anything. Well, what was the great mistake that they'd made?"

"Well," he said, "there was some men down here sent in a sample, down here at this tungsten mine, sent in a sample to the School of Mines, and they told them it had no value in it whatever. And so they let their claim drop, and they got nothing out of it."

So I questioned him and led him along because all the other miners were listening, and I wanted to get him out so he couldn't renege and back out. And so I said, "Well, if you're through with *your* story, I'd like to tell you the story the way I heard it, and I happened to be there myself." And I repeated just what I told you. "And the man finally

sold the claim for a great many thousands of dollars."

Well, he had something else more interesting to do, and he left the group and went out of sight. And I thought I had—you know, was in for a bad time because—exposing this man. But I couldn't help but to. The other miners come out and congratulated me because they said this man had needed somebody to—he was always boasting about what he had done, and so forth and so forth, but it was always around some place where none of these other men had been at the time, and therefore, they couldn't check up on him, although they were certain that he was boasting. The men were glad to see him get his just desserts.

Every once in a while, somebody would send us in something just to—oh, just for the hell of it, just to see if we knew anything, or as a gag, or what not. [Laughing] I remember once Professor Jones got some material that looked sort of greasy and brown-colored and so forth. And he put it into a test tube to see what it was, and it exploded. Turned out to be dynamite, a piece of old dynamite somebody sent in. But it had the wrapper torn off, and, of course, that's rather dangerous. One might have been injured if that glass had blown into his face.

But I remember another time, there was a man—one of our students was working for a mining engineer who was making an examination out around the Sutro Tunnel for some reason or other. So this man sent us in two specimens. One was a green mineral, just a little, small chip, maybe an eighth of an inch across, or something like that. And another one was a reddish, slender mineral in a white rock. And so we determined it. Professor Palmer called me in to see if I could help him out on these because they were silicate minerals. Well, the red one turned out to be piedmontite, which was named after Piemonte, Italy, and it's a manganiferous epidote. Now, most epidote is rich in iron. It's an iron-bearing mineral. And this one is low in iron and fairly high in manganese. And that's what gave it the beautiful red color. And, of course, that just took a glance down in the microscope, then, to determine that one because I had seen that mineral before back at Columbia University. That has since been discovered up in Nevada, along the Nevada-California boundary, fifteen or twenty miles north of Reno. At that time, there was none known in Nevada, or not widespread in California, either, for that matter.

And the green one—it just shows how—these are fairly rare minerals, but they're rather easy to determine because they're so distinctive. (Some of the commoner things are more difficult to determine, like ordinary water. Somebody'd send you in water and have you determine what that was. That's more difficult than some complicated things.) So, the green mineral, of course, turned out to be the green chrome-bearing garnet, known as uvarovite. And it occurs in pegmatite dikes here and there. There's some up here in the North Fork of the American River, and it's been found other places in California—none in Nevada, so far as I know.

And then, the other mineral, piedmontite, has been found, of course, on Peavine Mountain, and north of Reno near the dry lake, and some up in Oregon north of Denio. It's been found in quite a few places now of late—well, now, late is as far back as the '30's. But at that time, it was unknown. Those were sent in quite obviously just to find out if we could run minerals, just to check up on us. I don't know why, but anyway, that's the way it worked out.

It turned out to be that this mineral this man sent in to us, he was in touch with one

of our big universities down on the Coast because they were at that time working on this discovery. And it was a piedmontite that was discovered up at Shadow Lake, up in the mountains. I think it was Fresno County, or one near Fresno. It wasn't widely known at that time. I found out about it afterward.

But it also occurred in a tuft, a siliceous tuft (volcanic tuft), which they didn't seem to recognize. And that tuft was afterward sheared into a schistose rock, and so it was called a shale or a schist. But they didn't recognize it was derived from a tuft. We afterward found minerals like that up north of Reno, as I told you, about Peavine, and up along the state line. In fact, some of the old monuments on the 120th meridian, north of Dry Lake, the posts that were erected there, are held upright by large blocks of rock containing piedmontite. So, of course, people saw it way, way back in the '70's of the last century, but nothing was said about it.

[Laughing] I'll tell you another one that turned out to be quite funny. We had a man working—he wasn't on the metallurgical staff, he was employed solely for the determination of minerals and running assays. And he got a sample from Las Vegas, and the man wanted it run for silver and lead (probably came out of the Goodsprings district, off to the west of Las Vegas, because they have all the lead mines out there). And the next day, another specimen came in, also from Las Vegas, from a different person, however. The two specimens looked very much alike, and you could fit them together and see where they had been broken.(Whoever sent them in should've made a new break, you see.) And that riled this man up so badly. He ran an assay on them. And then he wrote them a hair curling letter that I thought was uncalled for. I always felt that one should not get riled at a thing like that. One should take advantage of that, of making a strike for himself (a bases-loaded home run, as they call it, a grand slain).

Because, as I told Henry, I said, "Now, don't get wrought up." I said, "Here, you've run an assay on it. You know it runs about thirty-five percent lead, and you know it runs about fifty ounces of silver per ton. Now, they want to find out how good an assayer you are. So let them know. You've already assayed one of them, and you know the other might run higher or lower than that, but these people don't know that. They think they should run identical. So, you send them in their assay—like it runs thirty-five point one five [35.15] percent lead, and it runs fifty point three three [50.33] ounces of silver.And on the other, make it run thirty-five point one oh [35.10] (just off five hundredths of a percent in lead), and run the other as fifty point three five [50.35] (just two hundredths of an ounce higher). And, of course, it didn't run that way. It may be of f many, many ounces, naturally. But they'll look at that and they'll think that you're one of the greatest assayers; they'll advertise you all over the country. Now," I said, "you write them a nasty letter, and you've lost friends and influenced people against you. You've gained nothing, except probably a little personal spite, or think you have. But for years and years, you've turned a flock of people against you when you *could have* made capital of it."

Well, those things happen time and time again. And I think one makes a big mistake not capitalizing on it instead of trying to f an his own estimation of himself, work up a sort of a mutual admiration society. But you should really cash in on those sort of things.

While one of my students, Marvin Newlove, was manager at the North Star in Grass Valley, I happened to obtain a fine specimen of gold-bearing quartz ore. But he didn't give it to me. This was during war times,

and you just don't give away any gold during war time—or, I mean, until recent years. You weren't supposed to beg, borrow, or steal, or so forth, any gold in this country—turn it all over to the government. Now, they don't want it. Anyway, I got that specimen by—well, we needn't mention it. I got it, period, so only I am implicated. I stole it, let's put it that way. You know, that's as good a way to put it as any.

It was one of the most beautiful specimens, and a very informative specimen because it shows gold deposited on pyrite, coating the pyrite, which helps to show the sequence of the minerals as they were deposited. And, of course, there, the pyrite was first, then came the gold later. It probably replaced the pyrite in part. But this was plated on it, just like gold plating. Which reminds me of a specimen we got, supposedly coming from Goldfield and had beautiful cubes. It was brought up to us to examine to see whether it was a good gold specimen. (I don't know whether I mentioned this before or not.) Anyway, it's an interesting thing of what happens sometimes. This man wanted two hundred dollars for the specimen, and he sent it up to us because he said it was gold. The prospective buyer wouldn't mind paying that much for it. And, of course, it would be cheap at that price nowadays.

But we looked it over, and you know, when metals crystallize, they very seldom make neat, flat-faced crystals. They're usually rounded or imperfect sorts of crystals—not always, but ofttimes, usually. I have seen some beautiful gold crystals in octahedrons and dodecahedrons from petrified wood out in central Nevada. But this particular one—so we looked it over. And I noticed that those cubes were nice cube crystals, but they had very fine faces on them, very well-developed faces. And the faces had striations on them. And every alternate face, the striations ran at right angles to those on the adjacent face. Now, when you get a thing like that, it's typical of what we call the pyritrohedral class of the isometric system. It's a class with a comparatively low degree of symmetry. And gold crystallizes in the hexoctahedral class, which is the highest degree of symmetry in the isometric system. And it does not have those striations on the sides. So, immediately, naturally, we're suspicious. Of course, it could've been gold replaced pyrite, but that would be rather remarkable, to have such a completely uniform replacement. So I took a needle and penetrated the gold on the back side of some of the crystals where it wouldn't show, and found the gold was only skin deep. And after examining the specimen for quite a long while, we discovered that they were electroplated. A beautiful job of electroplating, a marvelous job of electroplating! But they weren't gold crystals; they were pyrite crystals. You know, actually, that specimen would be well worthwhile now, as a novelty. I'm sorry I don't have it.

I might relate another incident that occurred in the state analytical laboratory. We used to have a laboratory that would analyze any—well, most—materials sent in from the outside, particularly rocks, minerals, ores, and we ran free assays for prospectors. That's all been given up; I hate to see it pass, but I suppose that's a sign of the times. And we used to get some very, very interesting things. Ofttimes, things were sent in to try to see if we knew anything. Sometimes, of course, we got stuck, but we'd try to work out most anything. One man sent in a piece of material from up in northern Nevada. And he asked, "Is this lithographic limestone, or—?" I forget the other name he had for it. Well, it didn't look like the other thing he mentioned at all, and when he said lithographic limestone, I knew he probably had seen lithographic limestone, knew something about it, because this

material had the same sort of grain. Professor Palmer called me in and asked me if I could make it out.

Well, I said, "Well, if it's limestone, it will effervesce with hydrochloric acid." And, of course, geologists often carry hydrochloric acid in the field to see if a rock contains any carbonates. And if they do, they will effervesce when acid's put on them—that is, as the little bubbles'll come up through the acid, carbon dioxide is given off. Well, I tried that, and not only did it not react with the stone, and no bubbles came off, but it formed a droplet that stood up away from the surface, like a drop of water will on something greasy. And that's unusual for rocks to react that way because they usually break down the surface tension of the acid—it just spreads out over the surface flat, or it certainly doesn't stand up in a rounded droplet. So I then scratched it with a knife and found out it was quite soft. So I scraped off a few fragments and put it under the polarizing microscope. And when I looked at it under crossed nichols (which are polarizing devices on the microscope), this thing showed a dark cross in little oval shaped—ovoid, I should say—shaped particles, shaped about like a cross section of a hen's egg. And in this was a cross, with the right angle bar up nearer the short end—rather, the short diameter, narrow end rather than the broad end. And the crosses flared out on the ends, like sort of brushes, like.

Now, it so happened that when I was at Columbia University, they had tray after tray of all sorts of things made into thin sections. Years and years ago—oh, it's been I don't know how many, seventy, eighty years ago now—they had a janitor at Columbia that got interested in making thin sections, and he made thin sections out of everything from feathers to door knobs and starch and wood, marble—anything. And I used to run over those when I got tired doing my other work. And I happened to run across some things that, too, stood me in good stead later. Because one thing I saw there was starch, starch grains (and the mineral piedmontite, which I hadn't seen otherwise, until we found some in Nevada) As soon as I saw it under the microscope, I recognized it immediately, and I recognized these things as being starch grains. And, of course, you wonder what kind of starch he had. Well, I told him that it was not a mineral and was not lithographic limestone; it was starch. What kind of starch, I didn't know—whether it was corn starch, flour starch, potato starch—but it was starch, anyway.

Well, by the way, after finding out that it had these ovoid shaped granules that showed a dark cross under crossed nichols, that simply means that there were crystals in there that were radiating from the center of that cross. And those that were parallel to the nichols would be black, dark (no light would come through), and those in between let the light through, and therefore formed the dark cross. And they had to be crystals and the light vibrated parallel to the long direction and transverse to the short direction. So any kind of crystal would have formed that cross, no matter what they would happen to be. So I knew this was not a mineral. So I scraped off some of it and dissolved it up in water and added some iodine to it, and it turned deep blue. That's a good test for starch. Take any starch and put iodine in it, and it'll turn blue. What the combination is, I don't know, but that's a good reaction. And I suppose vice versa—you could test for iodine the same way. If you had something you thought was iodine, dissolve it up in water and put some starch in it. If you get a blue coloration, you had iodine.

So, I guess he was perfectly happy, and we were, too, so I heard no more about it. So much for the potato.

A Prehistoric Flood

Well, I wanted to talk about big floods. We did use to have some big floods. I don't think I've mentioned this, but I did to somebody else just the other day. But there were lava flows that blocked the Truckee River at various times and raised the level of Lake Tahoe several hundreds of feet. And also, the glaciers coming down Squaw Creek and some of those other creeks raised the level of Lake Tahoe at least a hundred—a hundred or a hundred and fifty feet. And when those glacial dams were breached, being composed of fragmental, unconsolidated material, they must've gone out with a—well, just all of a sudden, maybe within days. And there, you'd have that hundred feet of water of Lake Tahoe rushing down the Truckee River, coming down there a hundred feet or so deep—terrific floods! And when it got down to Truckee, or out just below Truckee, it went straight out across where the highway comes out now, and you'll see channels cutting across an old pedimented surface (there's a level—practically level—surface). And these great floods cut out through there and cut these transverse trenches. And when you go down the Truckee River canyon below Reno, you'll find huge boulders that came from the Sierra, like granite and so forth, that we don't have along that canyon until you get way down to the far end of it. But you'll see boulders that came all the way from the Sierra Nevada and deposited high up on the canyon walls down there. They were probably also carried in blocks of ice that were floated down in this big flood. And when that ice would get stranded off to the side of the river and let the big rock down, there it would be. This big boulder I was telling you about, that the hypothetical Indians carried up and put down alongside the nonexistent fence, was probably put out there during a time like that.*

You can go down in the canyon and see the effects of those floods, something like the flood when Lake Bonneville, over in Utah, overflowed the dam up at Red Rock, and went over and down into the Snake River. And it produced terrific floods. And for a long time, that had not been recognized. The floods had been recognized here or there, and some down in Oregon that they thought were caused by the breaking of glacial floods up on the Columbia River (and some of them probably were).

But the great flood of them all was when Lake Bonneville went over the pass. And that was with alluvium, or unconsolidated material, and probably cut down at least half of it within a few days' time, or a week at the most. And it has been estimated that the flood going down the Snake River Canyon—that is, from deposits they found up on the wall—amounted to something like fifteen million second feet, which would compare with, oh,, a hundred and fifty thousand second feet for the big flood on the Yuba River, or two hundred and fifty thousand on the Colorado River, and so forth. So you can see, it was a terrific flood.

Earthquakes

Then, of course, I did a good deal of work mapping earthquakes, too, while I was at the University—that is, earthquake faults. And I visited older ones, like the faulting in 1915 up around Winnemucca, south of Winnemucca—about fifty miles south of Winnemucca. And there was faulting there at that time along a belt about fifty, sixty miles long. Then there was the earthquake of 1932 that Pat Callaghan and I worked on and

*See below.

mapped and also published on it, east of Mina. I think they called it the Cedar Mountain earthquake. Cedar Mountain's east of Mina, about twenty miles. The faulting along that was about forty miles or so.

An interesting thing is that this Pat Callaghan went to Columbia with me, took graduate work with me there. He went to Cyprus afterward as chief geologist, worked for [John] Burgess. And the last I heard of Pat, he was professor of geology at University of Utah. He was not a Nevada student, but he worked with some Nevada men.

And then in 1954, we had two earthquakes during the night, in December, I believe it was, and a fault along a stretch of, oh, probably sixty or more miles. In other words, it just about closed the gap between the faulting of the 1915 earthquake and the faulting of 1932. So, in a period of thirty-nine years, we had faulting all told over a distance of about a hundred and seventy-five miles—not continuous, but almost continuous. And when you look back at it, it looks rather like an outstanding feature, where we have all this faulting along a region where no earthquakes had occurred in historic time before.

Then I also did some mapping down in Owens Valley on the earthquake of 1872, which was a very violent earthquake, probably more severe than the San Francisco earthquake. I also mapped on an earthquake of 1951 or '52, I guess it was —that happened up near Herlong, just east of Doyle. It was east of Doyle. And we had a scarp there about six, seven miles long, not much displacement to it, only about seven or eight inches at the most. And that was along the Sage Mountains, they were called. There's a mountain called Stateline Peak and it's over in Nevada, and Turtle Mountains, which are in California. Stateline cuts right through near the center of the mountains. That did quite a lot of damage over at Herlong.

Then, at a later time, I sent down into Sonora, Mexico. I made two trips to northeastern Sonora to examine the earthquake faults that were formed in May, 1887. And that earthquake was probably the most violent in the West in historical tines—that is, in western United States—because it shook things up in southern Arizona, New Mexico, and west Texas. And that proved to be a quite an interesting study because there was a lot of movement across the fault where the west side of the fault had a relative north movement compared to the east side. It had been published on before, but there was a good many features that were not observed, like the faulting in solid rock and a scarp twenty-five feet high that was overlooked, and the bending of the surface of the ground as it approached the fault on either side (quite a curvature of the earth you could detect)

And, of course, what they couldn't see would happen then, but has happened since, was the entrapment of water in that desert country causing a rank growth of vegetation along the fault. There was desert vegetation there that normally grew six or seven feet high, but along the fault it grew fifteen to twenty feet high, and strikingly greener than elsewhere. And desert vegetation that never got any larger than two or three inches in diameter, along the fault was six or seven, eight inches in diameter—little trees out of what would have been shrubs out on the desert. There were a lot of features there and quite interesting.

It crossed the United States-Mexico boundary line that was surveyed by this United States Army man, you know, that held Little Round Top at Gettysburg. He surveyed that boundary line. And at the time

he surveyed it, the artist with them drew a picture of the monument that they set up on the west bank of the San Bernardino River (just a little creek), and he doesn't show any disturbance of the ground. But when the boundary line was resurveyed in 1892, a photograph shows a pond there with some Mexican soldiers called the *rurales*, Mexican soldiers that patroled the border. They were lined up along this little pond and a picture taken of them at the time. Now, that pond evidently wasn't there in the '50's. But it was there in '92, and probably was formed in '87 because we commonly get sinks like that along faults. Well, enough of that.

6

Some of My Hobbies: Beekeeping, Studies of Western Explorers

Beekeeping

Well, I started beekeeping along about '42 and kept bees up 'til—well, 'til I left Reno, about fifteen years or so. Oh, I had a few; I was not a big beekeeper, only had a few hives, sometimes three—two or three or four, or some times eight or ten or twelve, and just largely for the interest in taking care of the bees and for the honey they produced. I liked honey much better than sugar for sweetening, for most things. And there're a lot of interesting things about bees, and they're learning more all the time. I used to subscribe to bee magazines so as to keep up to date.

But there's been a lot of development about the bee industry since then, a lot of changes. They've bred up new varieties of bees, those that'll stand more cold, or those that will gather honey from flowers that the nectar lies deeper in. And they've done just a lot of things about the breeding of bees. By the use of artificial insemination, they were able to continue a direct line of purebred bees for many generations, and they could raise several generations of bees in a year, many generations. Because it only takes about fifteen days to hatch a queen bee from the time the egg is laid, and about twenty-one days for a worker bee. I forget the age for drones, somewhat different. They all come from the sane eggs, as far as anybody can tell. And the drone eggs are not fertilized; the worker cells are, because you can transfer a worker cell into a drone cell, and it'll hatch out to be a worker bee. And you put a drone egg into a worker cell, and it comes out to be a drone. But you put a worker egg into a queen cell, it'll come out as a queen because they're fed differently, and so forth. That appears to be the only difference between the queens and workers. They're both females, only some say that the worker bees are imperfect females and the queens are perfect. But that is not true. Neither one is perfect in some senses.

The queen bee is able to lay eggs and apparently has the ability to fertilize each egg as it's laid—that is, she is, if she wants them fertilized. Now, there's been a lot of articles written about that, by people that ought to

know better. They thought that the reason why the eggs were fertilized that were laid in worker cells was because the worker cell's the sane size as the regular honey cell. The drone cells are somewhat larger. I think the worker cells are about five to the inch, and the drone cell's about four, and the queen cells are, oh, from a quarter to about three-eighths of an inch in diameter and three-quarters of an inch long. They're quite large cells. But it's a well-known fact that you can take cells—honey cells that are just started to be made and that're no higher than an eighth of an inch—and a queen will lay fertilized eggs in those little cells that're only partially built. They certainly don't constrict her abdomen at all. And you can take those eggs out of those worker cells and put them into shallow cups for queen cells or even a worker egg, after it's been hatched out and not over about twenty-four hours old (because if they get older than that, something happens to them and they don't hatch out into good queens). But before they're twenty-four to thirty-six hours old, say, you can transfer these worker larvae, or eggs, into larger cells, and put those large cells into a hive that the queen has been taken away from (twenty-four hours or so), and those workers'll raise queens out of these eggs that you give them. And, of course, the queen'll turn out to be the type of bee that the queen was, or a mixture between the queen and the drone that she was mated with. And so, this thing of the constriction of the abdomen of the queen, to cause her to fertilize the eggs, is—there's nothing to that. It must be she does it of her own volition.

See, when the queen bee is fertilized, the semen goes into a little sac in her body, called a spermatheca, and the sperm is fed out from that sac as the queen lays eggs. Now, she can lay worker eggs, up to fifteen hundred a day, and fertilize all those eggs. And she can, right at the same time, lay into drone cells and lay nonfertilized eggs that hatch out to be drones.

Well, I found other things, too. There's some men back in Minneapolis at University of Minnesota that publish a lot and do a great deal of experimental work on bees. And they've reached some conclusions about the temperature at which bees will cluster inside the hive. When the temperature drops to a certain temperature, the bees cluster into a ball and stay that way 'til the temperature warms up. And they have given the temperatures at which this happens, and the temperature at which bees will fly out to gather honey. I've found that in Nevada, they don't cluster until lower temperatures has been decided upon, and that they will fly out at far lower temperatures, also—and particularly when it's snowy weather. If you get bright weather, clear sunshine, and snow on the ground, the bees'll fly out and hunt for honey at quite low temperatures, below freezing point. And probably because of the fact that our atmosphere is so dry, and the light is so bright (and they're attracted largely by light, although they live in dark hives), [with] this bright light and temperature up to about freezing, they'll fly out and gather honey in a dry atmosphere. In a humid atmosphere, they don't do that. And I think that's the reason why they had their temperatures different back there in Minneapolis than what I found out in Nevada. Of course, people coming from Nevada down here to California, they can feel the difference in the atmosphere. They can feel the humidity, and I imagine bees are much more sensitive to it than people are.

And then I experimented around with different kinds of bees. I had some Italian bees at one time, or what are called Italian bees. What's called an Italian bee are really raised up above Genoa [Italy]. They should be named

after that province there, there in that curve in northern Italy, just off of the Tyrrhenian Sea—and I forget what is the proper name for them (Ligurian). But that's why the bee is called the Italian bee. In northern Italy, in some sections of it, they have bees more like those they have in Europe.

And then across the Adriatic Sea, over in Yugoslavia, they have a bee over there—I can't think of the name of it now, by the way—but they are a gray bee; the Italian bee is a yellowish bee. The other bees, the name of which I can't think of now, live over in Yugoslavia and that region, are a gray bee because of a gray fuzz on them. They're quite gentle bees. They're gentle, more gentle than the Italian bees. But one objection we have to them is they swarm a great deal because they tend, in the spring, to raise many, many queen bees, and every time a new queen hatches out, they tend to go off with the swarm. That is, the older queen goes off with the swarm, and the younger queen stays in the hive. A population explosion to the neglect of producing honey.

And it used to be said that there was only one queen bee to a hive. Well, no, that's not so. Ofttimes, an older queen bee and a younger queen will lay side by side for some time, and then finally, the older one disappears. Usually, the bees kill the older queen. So usually, there's only one queen in the hive; that's the normal thing. But there can be two. You can put a screen in between the two. They have screens made out of rods that have spaces between then, or gaps through them, just large enough for worker bees to go through. But drones and queens can't pass through, as they are larger than the worker bees.And if you put a screen like that, and then a hive with honey above the brood chamber, and then another brood chamber above that with another screen so the queen can't pass from one to the other, you can have at least two queens to a hive. And some hives are operated that way. Some men think they get more honey by having a queen at the top and a queen at the bottom of the hive because she'll raise more bees and produce more workers by having two queens instead of one.

So I had some of those bees. They're gentle, pretty things, not very little, about the same size as other bees. And they're quite gentle, nice to work with, rather pretty bees because of this nice gray color.

Then there's a banat bee that lives, a native of Hungaria and that country. Then there's the Caucasian bees that live on the south shores of the Black Sea that are noted honey gatherers. They're hard workers. They probably work at lower temperatures than Italian bees will. They're a brown bee, and they're fairly gentle (what I mean by gentle [is] they don't fight and sting as much as some bees do), and they come out of the mountains down there. And they were noted around the town of Trebizond.

(And by the way, that was the place where—who was this Greek that went down and fought the Persians about 400 B. C. and defeated them and then retreated with ten thousand Greeks? Well, I'll think of his name later—Xenophon. Anyway, there was a Greek that went down with a Greek army, and a Persian prince, claimant to the throne, and they went down to displace this prince's older brother, who was then in charge of Persia, now Iran. And they got way down to Mesopotamia, and they defeated the Persian army. But the pretender to the throne was killed, the other generals treacherously murdered. And so they knew that a Greek army, without this Persian prince in command, would be not very well received in Persia, despite the fact that they had defeated the Persian army. So they had to

retreat. And this Greek who was with them, Xenophon, had gone along for the ride with this Greek Army. He was going to write up the history of the army, which he did. But when the pretender to the throne was killed, then, well, they were just left with an army without a commander that would not be well received in Persia. And so there was no hope for them despite the fact that they won the battle. So the thing was to retreat. Well, they had no generals that seemed to be able to handle things, and Xenophon took over the army. He was elected. And although he was a commercial man and a literary man, never had command of an army before, he turned out to be a very good commander.

But he retreated with these ten thousand Greeks, or what was left of them, up through northern Persia and across to the Black Sea, eastern Turkey—it might be a part of Turkey, too, probably is—and came up to the town of Trebizond. And when they got to Trebizond, the men ate a lot of honey, a very, very nice honey made by Caucasian bees, like I had some of. And it made the men deathly sick. It seems like none of them died of it, but they were deathly sick. And Xenophon mentions that. I have a copy out of his book about [it] because I was always interested in what happened over there. And what happened was that, in that section of the country, there's a lot of—oh, what do you call this little plant out here, those blues and pinks and reds, and so forth? Well, azaleas—certainly, azaleas. And there's azaleas there around Trebizond contain poison, contain some sort of a cyanogen compound. There's a small area up around Seattle that does the same, too. And there's some in the southern Appalachians. And it turns out it contains cyanide. Down there, they tell me that [when] they bring in wild honey, they throw some out and let the dog eat it. And if it doesn't kill the dog, then they let the other folks have it. And I guess that's where they got the expression, "Try it on the dog." But anyway, some azaleas are poisonous. There's a little clump up near Seattle where the beekeepers—you know, they keep rather quiet about this. They don't take their bees into that section because they know it does produce poisonous honey, and there's some poisonous honey produced in the southern Appalachians. But it's usually known where that honey is produced, and therefore, the bees are not ranged in that particular area. Well, it was down in these Caucasus mountains where Xenophon' s men were made sick on this poisonous honey.)

Then down on the eastern shore of the Mediterranean, they have a bee down there that has a little crescent on the back of his thorax. [Laughing] It seems strange it came out of the Arabic country where they use the crescent and star for the symbol. But they have a yellow crescent, and they are common on the Isle of Cyprus, what they call Cyprian bees. And they're very vicious fighters and stingers.

And then they have a bee in Egypt that's somewhat like that. And there's a bee down in the Atlas mountains on the side next to the Sahara Desert that looked very, very much like Italian bees, and they're probably quite similar to them. But they've never been brought to this country, as far as I know. In South Africa, they have a variety of bees that even the workers will—if they lose a queen—they will lay eggs that are fertile and can raise bees from it. It used to be thought that worker bees were absolutely infertile and incapable of fertilization. But it appears that there's all variations of that sort of thing among bees.

Then, in the Philippines and in India, they have a huge bee that's very vicious. They're as vicious as wasps, and men've been known to be stung to death from disturbing those bees.

They make large combs up to, oh, maybe a foot or two long and a foot deep and up to four or five inches thick. But they are a very vicious bee. And over there, too, they have a very small bee that makes honeycomb.

Now, talking about the honeybees, well, there's a lot of other bees that are what they call solitary bees that do not produce comb honey in the sense that our bees do. And they are individual queens, something like ants and termites, that one queen'll raise a whole bunch of workers. And with the solitary bees, they will raise a group of bees, and the next spring, each of these individual females goes out and digs a hole in the ground and raises another little bunch of bees, and so forth. They produce very little honey. Bumblebees produce very little honey, also. And then there's a bee down in Central America that has no sting, and they produce honey. But they aren't subject to domestication and to produce honey on a commercial scale.

Of course, our bees are not domestic bees in the true sense of the word because you never can domesticate bees. They go wild. And bees that've been raised in captivity for hundreds of generations, if they aren't captured when they escape from the hive, they'll go out and go wild and raise swarms out in the cracks in rocks or eaves or trees or under overhanging rock ledges in warm countries. They'll make combs and produce honey right out in the tree as long as there's shade, where they have shade and where it's not cold enough in the winter to freeze them out. Down in Arizona on the Verde River, there are cliffs there that there're dozens and dozens of swarms of bees all on the face of that cliff with their honey combs attached to the cliff.

Now, we didn't have any bees like that in America when the Europeans first came to America. The bees were brought over here from Europe. And the first bees they brought over were largely what they call a Spanish bee or a Dutch bee, which was a smaller, dark bee, which were quite vicious and difficult to work with. But they've all practically been exterminated by this time. And now the most popular bees, so far as I know, are the Italian bee and the Caucasian bee.

Whatever happened to all of mine? I sold them out. I sold out lock, stock, and barrel. I sold a honey separator and everything—bees, hives. And I'd have some down here [in Auburn, California], but we don't have enough room here. They'd be a nuisance to have here on a small lot. If I had a large place, I would keep some bees now just for the fun of it.

And, of course, they're wild in Nevada. Their bees are wild in even the coldest of countries. And I know, down on Bare Mountain, out of Beatty, Nevada, up on Bare Mountain, there are bees there that have been there for years in the cracks in the rock. You go inside these rocks, and they have their nests back in there. There're some in some rocks out where the diatomite plant is, over the Virginia range. You can go out there and go right across from the main workings and up on the north side of the canyon, a little gulch in there in a big rock outcrop. I suppose [if] you'd go up there, you'd find bees in there now. They were when I was out there last. And then there's a place up north of Sparks, up in those hills. There are bees up in those rocks. And then there was a place out southeast of Reno. I remember where there were some bees had swarms under the eave of a barn. And they made honey right out there in the open. But I suppose they were frozen out the first cold winter that came along.

Now, in Arizona, where it's warmer, they are right out on the rocks and even in trees. I've seen swarms of bees in trees with combs of honey, too. And the Indians called the

bees the "white man's fly." And as the bees came farther and farther west, the Indians could see the handwriting on the wall, that the white man was encroaching farther and farther upon his territory. That's about all I can tell you offhand about bees.

How did I get started? Oh, how do people get started in copper etching or painting or drawing or taking photographs or riding horseback or going hiking? Just a notion strikes you, and you thought you would like to do that sort of thing, and so you try it out.

Of course, at first, you're very timid about it and get stung quite a few times. I've been stung many, many times. You get used to getting stung and don't bother about it so much. Sometimes, you take cover, however, take evasive action to get away from these vicious bees. Sometimes they're gentle, and sometimes they're not. And some days, they're quite hostile. They're difficult to figure out; you can't tell when they're going to be vicious and when they're not. You can tell how to make them vicious, and you can tell how to treat them so they won't be riled up if they aren't already stirred up about something. But in some sections of the country, like where they have buckwheat and the bees get most of their nectar of f of buckwheat, it happens that certain flowers (and buckwheat is one), the nectar ceased to flow at a certain time of day. And when the nectar ceases to flow, the bees somehow get all irked about that, thinking that somebody's played a joke on them, or something, and they're pretty hostile. And so if you work around their hives at that time, they'll attack you, because they're already angered because of the fact the honey's stopped. And I suppose they're all ready to take it out on whoever they suspect caused that to happen.

Usually, if they're handled quietly and given a little smoke, which helps to subdue them—. Then, some people just have a knack for handling bees, and some don't. And I'm not one of those that are particularly good at that. But I've seen men who can go out and be in a swarm of bees, and they wouldn't put on a net, gloves, or anything, and they'd sort those bees all out and find the queen and put her in a hive, and, of course, all the bees follow right in. So they do all this barehanded.

We had an Irishman work for us, Jerry Gallivan. And ol' Jerry'd go out and capture swarms of bees. He wouldn't wear a bee net, and he wouldn't use a smoker—just barehanded. And he'd sort them all out, and they wouldn't sting him. He'd hunt around 'til he found the queen and put her in a box.

Of course, all the bees'll go in and follow the queen in. She has an odor so they can recognize her. They can recognize their own queen from some other queen, too. And if you put in a queen that is not acclimated properly, they'll kill her. So if you want to put a new queen into a beehive, you usually have to take out the old queen and dispose of her and get rid of her and leave the bees without a queen, not too long, because they start trying to raise one themselves. Sometimes, they'll raise their own. They'll build up a queen cell and go and get a little egg, not hatched, and transfer it over. And they have actually been known to do that, raise their own queen. And if they've started in on that, then they won't accept any other queen, once they've started to raise their own. But if you take a queen, removed the old queen for about a day or a day and a half, and put the new queen in and in a cage where the bees can't get to her to sting her to death, then they'll feed her through the cage. And after they have fed her a while, then they become accustomed to her odor. And then you can very carefully open the hive, now, without much disturbance, and let the queen out. Because if you disturb the bees too much,

they'll kill that queen, too. I don't know why they take it out on the queen, but they will.

Well, so much for that.

Explorers of the West

Well, now, something about Fremont. I think I'd better start back at the beginning.

When I went to Nevada in 1919, especially when I started teaching at the University in '23, they had a copy there of Fremont's report, which covered his second and third Western explorations from the Missouri up the Platt River, the Sweetwater, down the Snake to the Columbia, and then down through California and back through southern Nevada. I became very much interested in Western exploration. That's the first time that I think I had any particular interest in Fremont or in Western exploration. Well, then I've read that report through several times, and I've read, oh, quite a few books. I can't remember, recall them all. But I recall [Joseph] G. Bruff's diary written up and called *The Gold Rush*, published in [19]44, I believe it was, and then a shorter one—that was a two-volume edition. The shorter, one-volume edition came out in [19]48 for the anniversary of the Gold Rush in a single volume. And you know, that thing was a drug on the market for years. Now, you're lucky to get one for I don't know what—fifty, sixty dollars, I presume. And then I read a great many other diaries. I can't mention all—I don't recall all of them.

Well, then I read other people's reports on early explorations, both along the coast as well as inland, and the Hudson Bay trappers, and the Santa Fe Trail, the freighting out into Santa Fe and down into Mexico.

You know, even while the Mexican War was in progress, in 1845 or '6, there was a wagon train came out of Missouri to Santa Fe, New Mexico and then on down into Chihuahua, and on down to central Mexico, where they have a big fair and exchange goods. And their goods were very much in demand at that time because both coasts of Mexico were blockaded by the United States Navy. Now, mind you, these men went on down into the heart of Mexico and sold their goods and came back out again, through Chihuahua and back to Missouri again. And so, trading behind the lines with the enemy was done in those days as well as later, so I understand!

Then there was a man in Reno who was secretary to the Nevada Taxpayers Association, [Fred Nathaniel] Fletcher. I have his book, too. He went down and now lives in Berkeley, and I read his book. He put out a little book on early exploration in Nevada. So I read that. And while I was living at Marsh Avenue (Reno), along in the middle '30's, I took maps of the states of Nevada, Utah, and California, and so forth, and I read—. You know, Jedediah Smith's diary had not been found at that tame. All we had about Jedediah Smith's journey to the West were letters—one letter that he wrote back to General Clark of the Lewis and Clark expedition. General Clark lived in St. Louis, Missouri, and he was head of whatever they called Indian Service in those days. So Jedediah Smith wrote him a letter telling him what he had done. And then, after that, he went on this trip into California and up into Oregon, and ran into the massacre up on the Umpqua River.

However, in that book, Fletcher thought that Fremont had come down into Nevada out of Oregon, up Coleman Valley, and then into Long Valley (in northwestern Washoe County). But from reading Fremont's notes, I was thoroughly convinced that he came up Twelve Mile Creek, and his last camp in Oregon was on December the twenty-sixth, just north of the forty-second parallel, while

he was still in Oregon. And he took a reading on the North Star, on Polaris, and determined that he was at latitude forty-two degrees and a few seconds. And he said the next morning, they advanced up the creek, which came out of some high, snowy mountains. Now, the only creek he could've been on, as he described, he found in the southwest corner of what we now call Warner Valley, named after Captain Warner who was killed there in September of '49. Now, see, I'm just reciting this thing from memory, so I may have some errors in it, have to correct it. He then went up that creek and camped on it. And that's where he took the latitude reading of forty-two degrees.

The next morning, he went up the creek and after a travel of a short distance (now, how far that was, I wouldn't know, but I imagine three or four miles), he came to a sharp turn in the stream that rose in the high, snowy mountains. Now, he didn't say which direction the high, snowy mountains are, but the stream made a right angle turn. And he was moving south. So the stream then had to rise out of the high, snowy mountains either to the east or west. And the only stream that rises in high, snowy mountains there is Twelve Mile Creek. It rises in the Warner Mountains to the west of where he camped.

Had he come up Coleman Valley—there's practically no stream in Coleman Valley; there certainly wouldn't've been in late December or a dry year like Fremont was traveling through when a good many of the lakes were dry. He mentioned a great many streams and dry lakes that now have water in them. So we know it was a dry year, and he also mentioned that it was a dry year.

So he came up this left-hand stream. He took the left-hand stream and followed it up, and at the summit, they came through a little grove of large junipers of great diameter. And these were all covered with a heavy frost, which we now call "pogonip." That was probably the first mention we have of pogonip frost, Of course, he didn't call it pogonip. But the way he described it was similar to what was later known as pogonip.

And he came down into a large valley, and in a short distance they camped at a dry lake. That lake is what's now known as Alkali Lake in the northern part of Long Valley, in northwestern Washoe County, and about, oh, maybe three or four miles east of the California-Nevada boundary line. So he didn't go into California at all (so far). Now, another reason that I know he came up through there and not through this other valley I mentioned, that he had to come down through Long Valley because he showed several lakes. They couldn't be anything more than Cow Head Lake, which is now drained—that is, in California, and the boundary line runs just across the east edge of Cow Head Lake, and it flows north into, or used to flow—it drains now—northward into Twelve Mile Creek. And it was about at that point where that stream entered Twelve Mile Creek, where Captain Warner was killed in 1849.

He also shows a lake that's shaped exactly like what has for a long time been called New Year's Lake (about 130 years). That is well known to most everybody away from that country as New Year's Lake, but the local people call it Crook's Lake. So present day maps show it as Crook's Lake, although it's been on older maps, and most everybody in Nevada knows it as New Year's Lake. New Year's Lake is a very odd-shaped lake. It's practically straight on the western side; it's long and narrow. And on the eastern side, it has a short projection. Nobody would have drawn a lake like that from imagination. So Fremont must have seen it. And if he saw that lake, he must have come up that left-hand stream of Twelve Mile Creek as he spoke of,

rather than through Coleman Valley, in which there is no fork. And if he hadn't've seen New Year's Lake, it's not likely he would've drawn that lake in such an odd shape as it is, nor would he have drawn Cow Head Lake practically round, as it is.

Then he came down to this long lake that was dry, which is no doubt Alkali Lake, where he said they had sage brush up to twelve inches in diameter. It was at that point that he came upon some Indians out in the sagebrush in sort of a sagebrush huts. And they ran away to the rocky hills. And had he come down the other way, and out through the center of the valley, they wouldn't've been near any rocky hills for the Indians to climb up. And Fremont said they said, "Tah-be-bo." Now, Tah-be-bo, or Tybo, in Paiute language means white. You ask the Paiutes now, and they'll tell you Tybo means white, like the town of Tybo in central Nevada. Fremont said they said, "Tah-be-bo." (When Bruff came into that same general area, but several miles farther to the west, in California, when the Indians up there saw he and Peter Lassen and their group in the fall of 1850, they also said, "Tah-be-bo," when they saw the white men. So evidently, that was their word for white.)

So, that shows that Fremont surely came down that way. And he also shows his route as practically a due south straight line, which, had he gone up Coleman Valley, would have shown a deviation off to the east, a crook in it. Also, his map shows the entrance of the little stream coming out of Coleman Valley. He was on the boundary line on the twenty-sixth of December, because they fired the cannon on the morning of Christmas Day up in Warner Valley. So he was up there (Lower Warner Valley) on the twenty-sixth.

Well, on the night of the twenty-fifth, he camped south of the gap in the hills that leads up into Coleman Valley, showing definitely he *passed by* the entrance to Coleman Valley. So the people who think he went up Coleman Valley have yet to prove that he did.

Then he came down Long Valley, which everybody admits, and some think he went into California near there, which he did not. And he said that there was a snowstorm all day long, and I think he said they traveled forty miles, but really, it was fourteen. So when he dictated his notes, somebody got "forty" for "fourteen." Fourteen is more nearly correct. And he camped, he said, in the lee of some low hills in the valley. Now, those low hills are a group of volcanic hills, lava, andesitic hills, east of—a little south of east—of Forty-Nine Lake. And they're south and east of Vya, and they're a little west, six or eight miles south of Painted Point, which is a colorful rock formation to the east side of Long Valley. So he camped in the lee of those hills, which would mean that he camped on the eastern or northeastern corner because the storms come from the south or southwest.

Then he said he saw a gap in the hills to the southeast, and so they rode toward that gap. He didn't want to get any further down south, didn't look too good the way he was going and he wanted to bear off to the east, I suppose. To find the Humboldt River was what he was looking for, [and] Mary's Lake. He was looking for Mary's Lake, which we now call Carson Lake. The Hudson's Bay trappers had called it Mary's Lake, after Mary's River, as they called the Humboldt. So when he got into the gap of these hills and said the country to the east looked so forbidding he hardly knew which road to take. (Road in their parlance means route.)

Well, what they called a road in those days doesn't mean what we call a road today. It means not path, not trail, [but] direction. What route will we follow now? That meant a road. He said a road led here and there. It

wasn't a road at all. (And sometimes, they followed an Indian trail, by the way. I'll have to tell you something about that, too.)

So he said they went further down the hills and they came to the head of a stream, and they followed that stream down that night 'til they came to a spring, and they camped at that spring, and that there was another spring up on the hillside in a cluster of trees. Now, as near as I can figure out, that could've only been at the head of High Rock Canyon, near where the road from Hart ranch, Nellie Spring, and Indian Spring goes through over past Massacre ranch and joins—I think you call it Highway 8A that crosses northern Washoe County. Now, where that road crosses High Rock Canyon, it has a jog in it. It comes in from the west and jogs —it's running north, runs north. It jogs off to the east —that is, downstream, for half a mile or so, and then goes off to the east and to Massacre ranch and then joins Highway 8A. And Fremont said, when they came down this canyon, they found a well-traveled Indian trail that came in from the right and went down the canyon a ways, along their trail, then passed off to the east. And I presume it's about where that road runs now, just a natural runway. He said that was a strong Indian trail.

Then he came upon this spring, and they spent the night there. The next day, after traveling a short distance, they came to a part of a canyon through which they couldn't travel. Now, he doesn't say why; whether it was clogged with rocks or trees or too narrow. He said it was impossible to get through. So they went up around it and came in at the lower end because they didn't want to leave this little stream upon which they were traveling because water was scarce out in the desert, even in December. You see, they hadn't had many storms. And that was upper High Rock Canyon above Stevens Spring. And he describes the rest of it so that there's no question but it was High Rock Canyon. He came down through the high walls (where it got the name of High Rock), and he said the walls were so close together that they could see but a little sky overhead. Well, he painted the lily somewhat there.

You probably know the place. It's up above the big rocks they call High Rock, up between there and the meadow. That's the only place where the walls are really close together, and they are about, oh, maybe a hundred feet apart, and they may be fifty, sixty feet high. They're not enclosed. You aren't suffering from claustrophobia. And then, when he got down to High Rock, about a half-mile beyond there, the rocks on the north—well, you're going there about southeast. The rocks on the western side of the canyon are fairly high, several hundred feet, but they slope back. But on the left-hand side, where the caves are, and the emigrant writings you find there nowadays, the High Rock is about three hundred feet high, I would judge, and almost vertical. It leans back somewhat, not too much, but it makes it look like it's almost vertical. And that doesn't darken up the canyon or make you feel enclosed, either.

And they camped in that meadow above High Rock, and then he said in about an hour's travel, or something to that effect (it was a few miles—anyway, I judge it was only four or five miles), the canyon broadened out into what now is known as High Rock Valley and Lake. So he went right down the stream and out onto the lake bottom. And the lake was dry. And he says he thought at first he may have come down onto Mary's Lake. But he said, "We've found another of those interior dry basins," or dry basins, I guess he called it. So evidently, High Rock Lake was dry at that time. And then, he said he looked around to find the place out. And he shows

his trail, going right out on the lake bed. So it shows it must've been dry. It was right out where now we have water. And I've known it to be dry in the summer of [19]55, and I've heard of it being dry a few other times. So the year Fremont came down, again, it must've been dry year, or that lake wouldn't've been dry. It's always full on wet years. Sometimes, if overflows and goes down Fly Canyon.

Now, of course, what formed that lake in the first place, the High Rock Creek and Little High Rock Creek used to go out and down what is now called Willow Creek (that's the northernmost of the three Willow Creeks in that neighborhood). And sometime, some thousands of years ago, a great landslide occurred because there's a heavy flow of lava rock overlying soft clay-like lake beds underneath, or tuffs, volcanic tuffs. There may be some at the lake beds. I guess there are, because there were some vertebrate fossils found in them not too far from there. This landslide came down into the canyon leading out of what is now High Rock Lake and sealed off that little valley. And that's the origin of the lake. And you can see the shore line. It made a lake about three or four miles wide—about three miles wide—two and a half or three miles—and about four or five miles long. And you can still see the shore line in some places, and in other places, you can go up and find gravel wherever the shore line is. And it overflowed into what is now called Fly Creek and Fly Canyon. There was so much water in those days, it was able to maintain the lake as big as I said, and a hundred feet deep, I would judge, for years and years and years because it overflowed at a lower place in the lava and cut a gorge through solid rock—oh, some of the rock is soft rock, but some is quite durable. It cut a gorge there, oh, say, seventy-five feet deep. And in some places, it's in real hard lava rock. So the flow through there must have been thousands of years, to make that gorge. Now, when that happened, I don't know. But it must've been back a time when we had much heavier precipitation than at present, and probably back about Lahontan time, probably earlier than Lahontan time. I've thought sometime of making a study up there to see if that High Rock Creek, when it came out of that canyon, if it built a delta in Lake Lahontan, or if the shore lines cut across the stream, or something of that sort, where you could get some idea which came first, the landslide or the lake.

Then he camped in Soldier Meadows, and the next morning, they had to break the ice to get water for their stock to drink, which meant he must've been quite a ways from the hot springs where that water comes from. Because even in the coldest weather, it flows for quite a ways before it freezes over. So, he was probably down in the meadow near where Fly Creek comes out. I think that was the thirty-first of December. The next day, they fired off the cannon again to celebrate New Year's. That's the reason I know it was the twenty-sixth of December he was up on the Oregon border because he was only four or five days getting down there, you see.

And then he went south along the arm of the Black Rock Desert and camped part way down to the Black Rock. That was on New Year's Day, and on the second of January, he passed Black Rock and mentioned the hot spring with the steam rising from it. And he always called the steam smoke." He never used the word "steam" or "vapor," called it "smoke." That seems odd. He knew they were hot springs, called them hot springs, and all that.

Then he passed Black Rock. He took the—let's see. Those are not boiling springs, they're hot springs. I think he took the temperature of the springs as something like a hundred and sixty degrees Fahrenheit. He saw this black

peak, sharp, conical peak, and he judged that it was a volcanic peak, like I did from a distance 'til I got over to it. So he called it a volcanic peak and made a statement something like, "It had clinkers and coals around the base like around a blacksmith's forge." Now, why you'd have coals at the base of a volcano, I don't know. But there aren't any clinkers out there, no clinkers at all. And this peak is made out of volcanic rock. It's made out of volcanic tuff that rained down in the ocean because it carries Permian marine fossils in it. And in the central part of this peak, there's a band about a hundred feet wide of dolomitic limestone. So, of course, that wouldn't be a volcano. And the thickness of the volcanics there are—oh, I don't know, maybe ten thousand feet thick, maybe more. And they stand practically on edge. If he'd've examined it a little bit, he'd've found they were stratified rocks. But he wasn't interested in going into the details of geology at that time. I don t blame him. His party was in a bad way, running short of food, running short of horseshoes for his animals that were getting tenderfooted. And he was a long ways from Sutter's Fort, long ways from any place. You see, he'd been on the road now about a month, out of the Dalles, Oregon.

Then—I'd better hurry this up. Then he went across to the south side of the Black Rock Desert, straight ahead to the southeast, he said (which would be continuing his line about directly ahead), and he must have camped about and somewhere near the mouth of Rabbit Hole Wash, about where the Western Pacific siding of Chalona now is. And he turned westward. He said the desert looked so forbidding that he hesitated to enter it to the east, so he turned westward. And he turned westward, and for two or three days, they blundered along because it was so foggy. It'd take them two or three hours to find their animals, and by the time they got them gathered up, they'd only make a mile or two miles and then made a camp again in the dense fog. And he was afraid of losing his men or losing his animals out there. So, for about three days, they only made maybe four, five, six miles.

And finally, they came to what I call Mount Trigo. (I don't know what the name of it is. I think I'll write to the National Geographic Board and ask for that name.) And it's a gray mountain. It's conspicuous from as far as you can see it. It's the only gray mountain up there. It's gray granite, light-colored granite. Most of the rock up there is a dark gray granodiorite, or something of that sort. And Fremont climbed it and got above the fog, and he said it was made out of blocks of granite (he's a good observer that way).

And when he was on this route, one place he camped where he said he was on the contact between the granite and the volcanic rocks, and the first time he'd been off of the volcanic rocks since coming upon them on the Columbia River. So he'd been traveling all that time on volcanic rock. And that's a good geological observation. And it also helps to mark his point there, because he gives the latitude (and the latitude is an east-west line), and the contact there runs about north-south, so you can get roughly the spot where he was within, oh, a quarter or half-mile at the most.

And when he climbed up on Mount Trigo (there's a railroad siding there called Trigo, which, in Spanish means "wheat") and then he saw "smoke," as he called it, from the hot springs at what is now Gerlach. And he said he judged it was about sixteen miles away. When he got over there, it was sixteen miles. They had a pretty good way of marking distance; they were quite accurate; at times, surprisingly so. I think they judged about how fast a pack

outfit like that traveled in an hour and how many hours they traveled, and they took out the times they stopped, and so forth. So they got a pretty good idea of the distance they traveled during the day.

They got over to Gerlach, Gerlach Hot Springs. They called it the "Great Boiling Springs." And he stirred them up, and he got a temperature, I think of two hundred and eight, if I remember correctly, or two hundred and four, I forget which—two hundred and something Fahrenheit. And he said that he thought the temperature'd be higher if he could have stirred them up better and got a temperature from out of the middle of the boiling water. But he evidently got the correct temperature, because that is the boiling point of water at that elevation, which is around 4,000 feet, I believe. So he evidently got the maximum temperature of the boiling spring.

(Now, there's a little sequel to that. Once, when I was in Gerlach, one of the former students of the University of Nevada was the superintendent of schools up there. I don't remember his name now. He played on the basketball team. And he was superintendent of schools, and I went over to a Parent-Teachers Association meeting just to pass the time away of the evening. And I was sitting back there having a good time, and—well, you know, it's always the bystander that stops the stray bullets in any kind of a brawl. So I was just having a very good time, and finally, he said, "We have with us this evening a man that—," you know—so I was nominated—"and could tell us something about the geology of the area."

So, I got up and hemmed and hawed a while and told them how happy I was to be there, and so forth, which I wasn't at all, [laughing] and finally decided that I could tell them something about the geology, but there wasn't a great deal I could tell them that would interest the general public because most of them didn't know enough about geological terms to understand what I was talking about. So I told them something about the limestone down south that the gypsum deposits were in, and I'd been out to see those gypsum deposits tack in 1919, the first summer I came up into Nevada, went out there to see them with a man by the name of Foster. And—well, that's another story.

So I told them about Fremont coming through there and about Black Rock, what Black Rock was made out of because I'd been out to Black Rock before that and we'd found these fossils out there, and we'd found it was made out of volcanic tuff or breccia that rained down into the ocean. There's some beautiful corals in it. They were all marine animals, and the furthest west Permian we know of in the northern part of the state of Nevada. I afterward found some off to the east of there, too, at the Hog Ranch. East of the Quinn River, across from it, we found some more Permian over there, much more fossiliferous than this is and without the volcanic rocks in it. And they had big horn corals, and they had some very abundant fossils that occur on the top of the Permian. I can't think of the name of them now—fusulinids.

Anyway, I told them about some of those things, and then I told them about Fremont's trip down through there and that Fremont had camped here, oh, January eighth or ninth, somewhere—sixth or seventh, something like that—1844.And I said, "Now, you have some hot springs out here called the Gerlach Hot Springs.And we have the Elko Hot Springs. We have the Carson Hot Springs. We have *these* hot springs and those hot springs, none of them with any distinctive names except the Seven Devils over in the Dixie Valley. Now,"

I said, "you know, it would be a nice thing to reestablish that name, the 'Great Boiling Springs.' There's no other springs that I've ever heard of called the 'Great Boiling Springs,' certainly not in western North America."

So that was that. I think that was along in the '60's sometime. And sure enough, the next time I went up through there, here was a big sign up, "Great Boiling Springs," [laughing] "named by John C. Fremont on January (so and so), 1844." Now, since that sign was put up, the campers just flock into those hot springs. It's some place to be, now. It's made it a very popular place. You can see what a name—-some people say there's nothing in a name. Well, don't you believe it. There's a lot of things in a name. By any other name, it'd be just as much of a spring. But that got them! And a piece of history to interest people who come through.)

From there, he sent his horses up to what is called Granite Creek for pasture. That's the little, old Granite Creek, not the Granite Creek ranch, but another one about four miles out of Gerlach—north of Gerlach, which the emigrants later used on their way west. Now, here's where the emigrant trails crossed Fremont's trail.

I might as well bring that in now. The Applegates, when they came down out of Oregon in 1846 in July, with eight or ten men (there were two Applegates and I think ten other men with them), they knew of Fremont's work, that Fremont had been through that country, because his report came out in 1845, and a lot of people out in the West had Fremont's report. And Fremont had met the Applegates when they went down the Columbia River. Well, they passed the Applegates with a group of other emigrants going into Oregon, and these emigrants had stopped to make boats. And Fremont's party passed them and went on down the Columbia River. You know, there's a long stretch there, oh, fifty miles or more, just an open, sandy country. And they stopped at the Dalles. And these boats passed Fremont on the way. But they had to make a portage at the Dalles because there's a dangerous rapids there. And one of the Applegates' children was drowned. A canoe overturned. And Fremont makes a note of that. Then, of course, the Applegates knew of Fremont, and, of course, they knew of his report when it came out, and they had his report.

You see, in 1846, it was touch and go with the United States and England over the northern boundary from the Rocky Mountains west. And a lot of people were willing to give up to the English down to the Columbia River. But most people wanted to claim clear up into British Columbia. Well, we had a treaty with Russia that their southern boundary line would be fifty-four forty. And that's where that slogan of "Fifty-four Forty or Fight!" came out. Then, finally, they compromised on the thing by running the forty-ninth parallel, which had been established as the boundary of the Louisiana country, had been established in 1818 as the forty-ninth parallel to the top of the Rockies. So then, they just ran the forty-ninth parallel straight on through to the Puget Sound country, and then zigzagged down through the islands and out the Straits of Juan de Fuca. Well, some people were very much worried for fear that there may be a war with England over this thing. Fortunately, it was settled in 1846 without any problem.

The Applegates wanted a route into southern Oregon for two reasons. One was that they were settled in southern Oregon and they wanted more settlers in southern Oregon. And another thing was to make a new route into Oregon where Americans wouldn't have to go down through the country

all controlled by the Hudson Bay Company, you know, which held, oh, a little tort up there on the Snake, you know, near Pocatello. What was the name of that old tort? Fort Hall. Anyway, then they had Fort Boise, and then they had a tort down where the Snake enters the Columbia, they had a tort there at Vancouver (now in the state of Washington).

So, Fremont knew the Applegates, and the Applegates, of course, knew of Fremont's report. So they decided in '46, in July, to come up the Willamette River, up past what is now Medford and Ashland, Oregon, and then went up Emigrant Creek, which comes down (named by the emigrants coming down) and took that diagonal length to the southeast, and up over the Siskiyou Mountains, about onto the Oregon boundary line. And up there, they came across what they thought was Fremont's camp, where he had gone up to Klamath Lake in 1846 (and we'll mention that later). Then they went on east, past what's known as Tule Lake, which Fremont called Rhett Lake (in our old geography books, when I studied back in the late '90's, they still showed that as Rhett Lake. They changed it to Tule Lake at some later time). They went on to Clear Lake, due east, and then they diagonaled down to the southeast and finally came to Goose Lake (what's now called Goose Lake). And then they went over Fandango Pass, we presume, and into Long Valley. And when they got into Long Valley, they found Fremont's trail. And they followed it down High Rock Canyon and on down past Black Rock, across the Black Rock Desert to Rabbit Hole Wash, about where the Western Pacific siding of Chalona now is. (And there, Fremont turned to the west over to Gerlach. Now, we'll take up his trail from there when we get through with the Applegates.)

The Applegates went up Rabbit Hole Wash, and this was along in July, and it was very, very hot. They wanted water in the worst way, and they were looking for a spring. And they noticed some animal trails that were rather faint at first. But these trails converged as they followed them. So they thought they would lead to water. They went up the wash, probably five or six miles, and they saw this trail turn up a bank on their left. So they followed up the trail, and there was a hole about, oh, six inches in diameter and about a foot deep, where the rabbits had been going down to get water. And from there, the name Rabbit Hole was named. And the present Rabbit Hole on the map is Rabbit Hole camp, which is about three or four miles farther up the canyon. That is known now as Rosebud Canyon. That became the emigrant trail into Oregon and northern California that same year. And then, in '49, there was a lot of people came over that trail, probably 10,000 or more.

Well, then, when they got to Rabbit Hole, they continued up the wash, instead of going up Rosebud Canyon. They turned of f to the south and went through the Poker Brown Pass and then over to the Humboldt River. And when they got up to the big bend in the Humboldt, near Mill City (where Mill City now is), they realized they made a big loop. So they sent some of the men back to connect up with Rabbit Hole Spring, so as to shorten the trail, whereas some of them went on up the Humboldt River, the remainder of the group. And they met some emigrants.

They told them that the emigration was on, and it was getting near the tail-end of it. So they hurried over to Fort Hall, on the Snake River in Idaho, just a few miles out of Pocatello, what is now Pocatello, Idaho, and intercepted some of the emigrants, among whom was—hmm, can't recall his name now. He was a prominent man in Missouri, and he would not go with the Donners. He decided to take the other route, and he was "out of the

frying pan into the fire." I believe his name was Boggs; he wrote a book afterward. He was very bitter about the Applegates taking them over an unbroken trail. They had to make road all the way, and they had a lot of difficulty. They had fights with the Indians; they lost, oh, so much of their household goods, a lot of their animals. So when they got into Oregon, they were a couple of months on this trip. They thought it would only be a few weeks. And they wished they had gone down the Snake River and the Columbia. So that constitutes the Applegate Trail.

Now, that was followed later by, oh, quite a few emigrants, and then Peter Lassen came over it in '48, coming back from the East with a party of settlers. And he was taking them down to his ranch up near what is now Vina, in northern California, on Deer Creek, where he had a land grant. He became bogged down up in the Sierra about thirty miles short of his destination. He had too many women and children and not enough men, and the men he did have were not woodsmen; they were farmers and settlers.

And by the way, the southern end of his land grant is now the Wilson ranch, out of Nord, California, which is about eight miles north of Chico on the Southern Pacific railroad. My father's ranch, that he bought in 1903 and which I helped to survey (that's where I got my first interest in surveying and engineering. I was just a youngster in my teens then)— well, the Wilson ranch joined the ranch my father bought on the north. And that was the southern end of the Lassen-Bosquejo grant. (A lot of people thought Bosquejo comes from the word *bosqua*, meaning brush. And they thought it was named the "brushy ranch." But I understand it's a Spanish word that means a sketch map, *bosquejo*. And so it's called the "sketch map grant." In other words, they made a rough sketch of the country, and that was the map of his grant.)

And about that time, a group from Oregon came down along with Peter H. Burnett, who became the first civil governor of the state of California. They heard about the gold excitement. Lassen knew nothing about it. And these Oregonians came down with wagons, and they were all comparatively young men. They were all woodsmen. They had worked at clearing their farms in Oregon of timber, so that they all knew how to handle axes. It was no time at all that they cut their way through the timber and helped Lassen's group on down to their ranch.

And by the way, they settled down, this group of Oregonians with Peter Burnett, a part of them at least, settled down up near Table Mountain, north of Oroville, at a little place called Oregon City, and mined there. They called it Oregon City because most of them were from Oregon. And about four or five miles farther north is the famous Cherokee mine that was named for the Cherokee Indians, a great many of whom came west during the Gold Rush—also, other Indians, Wyandotte, for instance. The little town of Wyandotte, California, there was mining—now it's an olive-producing area up in Butte County, not far from Oroville, between Oroville and Bangor. There was a little mining in there. And that was named after the Wyandotte Indians. Well, now, so much for the Applegates.

By the way, the trail the Applegates broke was later followed in '49 by about somewhere and around eight or ten thousand people. And they took that long, roundabout route into northern California. But it wasn't used but a few years.

Then, to get back to Fremont. We left him, I believe, now, at old Granite Creek. There was a heavy fog when he went through; you

see, now it's January, January '44. And there were heavy fogs over those valleys and over the desert like there are nowadays at times. And the stock strayed out across the desert, and the men had to hunt them up in the fog, and they were sometimes two hours or more getting started in the morning. And they couldn't go very far because [it was] so foggy they couldn't see where they were. So there was several days there when they didn't make more than, oh, probably eight or ten miles. And they had lost seven head of animals out on that desert. [Laughing] And at one time, I always thought of going out across that desert with one of these electrical devices for discovering buried metal, thinking I might get some of the old horseshoes he had because he complained of being short on iron for horseshoes. Also, I think a good deal of the lead he had for bullets was also lost up there. It would be interesting to have some of those things. Later on, however, I realized that thousands of emigrants had followed that same route, and, no doubt, they left a lot of iron around there, and metals of various sorts. So it'd be hopeless for finding— well, it'd be just a rare chance if you'd find one of those seven pack animals' load lying out there in the desert some place. It'd be interesting to look for it, however.

I think there was the stream we used to call Cottonwood Canyon. Now they call it Rodeo, or something of that sort. There's an old mine up in there. And it's one of the few canyons in the north end of the Fox range. They call it by some other name, too, Wild Horse mine, or something. It was the only—or one of the few canyons up there that contained any water. So he camped at the one that had water in it, and I think that was the one that used to be called Cottonwood.

And then, he went due south from there, following an Indian trail, and on up over the ridge and down onto Pyramid Lake. He saw Pyramid Lake from the divide. He went over and down without any trouble whatever. So we know he didn't go down through Hell's Kitchen, about two miles south of there, because nobody would have gone down through there without telling of all the trouble they had letting the horses down over the cliffs, as well as the canyon. So they came down on what is now known as Sweetwater Canyon. He said there was a stream of pure water. And the way he describes it, and the shore line of the lake, and his map shows the northeast corner of the lake right about opposite the canyon mouth could be none other than Sweetwater.

And then he went south from there and left the cannon overnight on the cliff, granite cliff, and camped the next night at—there's a day lost there in his notes, and just where that comes in, I don't know. On the fourteenth day of January, he camped opposite the Pyramid, and while he was there, his artist, [Charles] Preuss, drew a picture (P-r-eu-s-s, like our old greenhouse man up at Nevada [Herbert Preuss], I called him Mr. "Proiss" one morning and he just beamed. He said, "I've never heard that name for years. The people always call me 'Proose.' They never say 'Proiss.'"). So, the artist drew the sketch of the Pyramid and some of the little islands there. And he drew a picture of Fremont' s cannon, so we know what the cannon looked like, no guesswork about it. It's not the cannon that they have down at the Carson museum, you know, and so forth.

From there, they went down to the Indian camp at the end of the lake. And apparently, Winnemucca Lake was dry because the Indians drew a sketch, and this was a dry year, as I told you before. Fremont mentioned several times it was a dry year, and furthermore, High Rock Lake was dry. And it

doesn't go dry except on very, very dry years. And maybe Winnemucca [Lake] was dry at the same time, because the Indians don't say anything about Winnemucca. And the artist, when he drew a sketch of the country, he shows the slough (that is now known as Winnemucca Slough and now dammed off; it used to conduct water from Pyramid over to Winnemucca), he drew that as though it flowed down out of the mountains. So evidently, it didn't have any water f lowing off to the north, or he didn't notice it. And they had a big feed on salmon; that's the first mention of the salmon in Pyramid Lake, salmon trout.

From there, he went up the next day up to the bend in the river at Wadsworth. Now, the Indians told him that that river came out of the mountains about three days' journey to the south, and there was a lake at the end of it. And beyond were two streams that men like himself traveled—in other words, white men, Europeans. I presume they meant the Feather River, or American River, and possibly Yuba River. That shows up later in some of Fremont's maps. I believe he went on, then, over to the Carson River, past Fernley, right down through that open gap leading over to Silver Springs, and down the Carson River to where the river forks. He said he couldn't tell which way the water flowed. I guess there's practically no water going down it [during] a dry year, along in December or January, very little snow or rain. He looped back over what is now known as the Dead Camel Mountains, and came back upon the loop in the river, oh, maybe eight or ten miles upstream from Silver Springs. And he drew this s-shaped sort of loop in the Carson River very much as it's shown on maps today.

He gave us the latitude of both of his camps, so you can put those down and tell pretty close where he was because his latitudes were usually quite accurate. He didn't give any longitudes after leaving Oregon because his chronometer'd gone—something went wrong with it. In fact, he had two chronometers to start with. He didn't say anything about the other chronometer, only mentions one now, and it finally stopped entirely.

So he went over to the Walker River and up the Wilson Canyon and looked across Smith Valley and Hoy Canyon that the West Walker comes down. And it was still snowing up in the mountains, so he didn't go up that way. He didn't go up the Carson, either, because it was snowing in the mountains. Now, these were light snows, however, not nearly as bad as we usually have now. And then, he cut across after coming down out of Wilson Canyon and observing the country, he went across where the road goes now, through that gap that finally leads over to the West Walker, near the Walker River ranch, and up the West Walker, and over the divide to the south, where those coal prospects now are. [He] describes the rocks there very well, what we now call Kate Peak andesite, and camped on a stream (I think they now call it Eight Mile Stream). And the next morning, they had to break the ice to get water for the horses. At that time, an Indian came down and gave them some pinyon pine nuts; And it was there, near the Pine Grove Hills, that Fremont first encountered the pinyon pine in Nevada, and gave it its name *Pinus monophylla*. His botanical collections were described by Torrey. Fremont was a fair botanist in his own right, an amateur botanist. But they were written up by Torrey, and quite a few were called *fremontii* this, that, and the other thing, like one of the cottonwood trees and some of the plants. We have some of the fremontii cottonwoods up in Nevada. Well, that's where the pinyon pine was named.

Then the old Indian gave them pine nuts. Those Indians used the pine nuts for food. They collected great quantities of them. These

were the Washo Indians, which lived up in that neighborhood.

Then they went up over a ridge, got an Indian guide, took them up over a ridge past what is now the old settlement of Masonic. When they camped at the big spring there, the Indians killed an antelope and gave them part of it. They saw a great many deer, deer tracks. They camped in the valley where Bridgeport is now, just above the junction of the two streams there. That junction is now under the waters of the Bridgeport reservoir.

Then they went up the canyon (I think it's called Huntoon Canyon) that leads along Highway 395. They followed up that past the hot springs. Oh, what's the name of those springs? You know, where Devil's Gate is? And he's described that as having granite on each side, which it is, granitic rock. Fale's Hot Springs. That's right. He mentioned the hot springs, and he said they kept up on the hillside to keep out of the snow, which, of course, would mean that it would be on the southwest facing slope. So he turned to the right as he passed the springs and came over the hills and down onto Deep Creek. And there's where the cannon was left, which was since found and taken to Virginia City and probably melted up for scrap metal.

Then he was on the West Walker. He became confused there because later on, he determined his longitude, or tried to get the correct time, and he was trying to do practically the impossible under those circumstances at the time. Nowadays, it'd be a simple, a very simple matter, to get their accurate time. But he got too far west by twenty-seven miles. So, instead of continuing his map by dead reckoning, as he had been doing before, he tried to correct it to his new longitude. And therefore, the lower portion of his map, just north of Lake Tahoe, if he'd sliced the map and slide it twenty-seven or -eight miles to the east, these streams'd all check up correctly. So he took the upper West Walker to be a part of the Carson River. And when he got over onto the Carson, he thought it was the headwaters of the Truckee (which he called the Salmon Trout River). So, being that he was told that there was a lake up at the head of it (the Carson), he draws in a lake off to the south and dashed it in to show it was hypothetical. From there, he went on past Grovers Hot Springs, Markleeville, and up over the summit, just north of Elephant Back (not through Carson Pass, as most people think), and then down the ridge from Red Lake Peak to Strawberry. And he had Sayles Canyon on the right, and Strawberry Creek on the left. They were on the ridge two or three days.

Now, they came over the summit on February the twentieth. Now, it took them from February the fourth, when they reached Markleeville, until February the twentieth to get to the summit. So, you see, they were up there about sixteen days. And then they were another seventeen days getting from the summit down to Sutter's Fort. Surprising—they were just a few days going down to Strawberry, and the first day down in the canyon, they got down practically to Riverton. That was good going. They were out of the snow then. The horses got the first grass eight or ten miles down the river west from Strawberry at Kyburz, the first grass they got since leaving the mountains. And the horses were practically starved.

And from Riverton, they went straight down the west side of the river through a very rugged country where there isn't any east-west road, even today, and past Rock Creek, which Fremont named, still retains the same name. They came down to the valley at Coloma and passed Pilot Mountains over here, just to the south of us (Auburn) a few

miles, and crossed the North Fork, and from there, headed for Sutter' s Fort. Well, he went from there up the San Joaquin Valley and out through Tehachapi Pass over to the Mojave River and picked up the Old Spanish Trail and followed it off to the east past a series of springs that he named (none of which retains his names now), through Las Vegas, which had already been named by the Spanish. And the Amargosa River he mentions, too, as apparently already named by the Spanish, and he used their name. So he knew the Spanish names for these places. And then on back to Utah Lake and on east, and home.

Now that was that trip. A great many people (in 1846 and 1849) followed his route from Rabbit Hole Wash on up to Long Valley, oh, a distance of, I guess it's about a hundred miles—seventy-five or a hundred miles—from Rabbit Hole Wash until they got out of Long Valley in northern Washoe County. That became an emigrant trail, as I mentioned before. Eight or ten thousand people passed over it in '49, a few in '50. And then, in '51, they used Noble's route, which is a shortcut from Black Rock, and finally, from Trigo directly to Gerlach, and then over to Smoke Creek and on over to Susanville and Big Meadows, or what's now Lake Almanor, and used that for the route to the northern mines.

Now, the next trip Fremont made out here was in '45. I'll just summarize it briefly. He came westward through the Rockies and through South Pass and through to the Great Salt Lake. In his earlier trip, he went to Salt Lake and surveyed it and gave his latitude and longitude. And when it was resurveyed in more detail in '49 by the Army engineers (they spent quite a few months surveying the country out there), they used Fremont's longitude, which was fairly close, because their chronometers went wrong and they couldn't get a true longitude.

So he came to Salt Lake. And, by the way, as he went east the year before, he met Joe Walker, who was returning from California. So, of course, he talked over with Walker about these various routes. And at that time, Fremont named the Great Basin, where that had inward drainage, and the term has come down to us to this day. The geographic term means the basin of interior drainage, which would take in Lake Tahoe and Bear Lake up in Utah, et cetera. All the streams that flow inward into it and all the drainage, that constitutes the Great Basin.

Then, when he got to Salt Lake in '45 now, this was in December again. He seemed to love to travel during the winter, and it brought him to grief on several occasions. This time, he came along the south edge of the Great Salt Lake. He had with him this time Joe Walker, Kit Carson, oh, quite a few of the old timers that knew the country. But none of them knew anything about what lay west of Great Salt Lake. The Indians couldn't tell him anything, either. But when he got to Skull Valley—now, this is where Jedediah Smith wound up on his eastward trip in 1827, when he came across the desert and almost died; he came to Skull Valley also.

To the west of this valley is a ridge of mountains; I can't think of the name now—Cedar Mountains. And he broke the trail through there that was later followed by the emigrants. It was called the Hastings Cutoff. Hastings didn't find it at all; Fremont found it. And this was the route that was later to be followed by Hastings, leading a group, and by the Donner party that came without any guide whatever and caused them to be late crossing the Sierra and led to their almost starving to death up there, which a great many of them did.

Now, when he got up on this ridge to the west of Skull Valley, he saw a peak way off

in the distance that he judged to be seventy or eighty miles away (it turned out to be seventy-five miles). And he sent some of the party on ahead to reach that peak. And he felt quite sure that there'd be springs at the foot of it. Well, fortunately, there were. Of course, there's timber up on the peak and it would indicate it. It was quite a high peak, standing off by itself. And he named it Pilot Peak, the name it still has. So they crossed the desert and came to the foot of Pilot Peak. Now, he doesn't mention a thing about any wagons being found there, nor any sign of traffic. But the Bidwell-Bartleson party passed that way with, I forget, twenty people or more, in '41. So their tracks or their wagons must still have been there. They were observed by Bryant in 1846. But Fremont doesn't mention anything like that. And they left some of their material, I know, at those springs, but most of their wagons at the springs at Johnson's ranch, south of Oasis, Nevada.

Then he went south from there, about to where Wendover now is, and up in the range to the west of Wendover, the Toano Range, and established camp. And the next day, he crossed a valley and another mountain range and camped at another spring that he named Whitten Spring. I think now it's known as Chase Spring. And by the emigrants, it was known as Mound Spring. (There's been confusion about the location of this spring. Some think it's at the Johnson ranch, where they now get water that they pump now over to Wendover. Some think it was Flowery Spring, farther to the east. But he shows the crossing two valleys and two mountain ranges after leaving Wendover. So it had to be Mound Spring. And he also gives the latitude of it, which is quite accurate, and he gives the longitude, also, and that locates it, although his longitudes were too far west by six or eight miles. But that was the spring, all right.)

Then he split the party up there, and he sent some of them through what is now known as Secret Canyon, previously used by Bryant's party, down to the Humboldt River, and on down the Humboldt to Walker Lake. And he took of f diagonally southwest across Nevada to meet them at Walker Lake, which he did. Now, that group went on south under the guidance of Kern and Walker. Joe Walker was their guide (he'd been over the route before), and Kern was the topographer. They went down and through Walker Pass into California.

Now, Fremont went from there over to the Truckee River, near Wadsworth, and up the Truckee, and camped somewhere about the middle of December just at the eastern foot of Donner Summit. And he went over the pass in mid-December—practically no snow—and followed down the ridge about the way the highway (I-80) now runs, and to Sutter's Fort at Sacramento. And then he went out hunting for the other party, which had camped up on Kern River, and there was a mixup there. He thought they'd be on King's River, which they weren't, and he rode way up into the mountains there and got caught in a snowstorm and had to hurry back down. He left his cattle up there; he was driving some cattle for food for the other group. He returned to Sutter's Fort, and he sent Carson and somebody else down and finally found these other people.

Then he took a trip up to Lassen' s camp, and Lassen wanted him to go directly east as he wanted to go up to Klamath Lake. But he didn't take that route. He went on up to about where Redding now is—not quite to Redding—and went up Cow Creek. (Now, Cow Creek got its name from the wild cattle that used to roam there, from cattle that got lost from the Oregonians' taking cattle from California up into Oregon. So there're a lot of

wild cattle there in the early days. People went out and shot wild cattle like you would shoot deer or elk nowadays.) He went up over the pass, probably somewhere near what is now Hatchet Creek Summit, or Hatchet Mountain Pass (I forget which the name it is), and down onto Pit River, near Fall River mills, and up Pit River to Big Valley, which he named Round Valley. (That's been called, now, Big Valley, and Round Valley's been transferred to the one near Fall River mills with all the large springs in it.) And from Round Valley, he cut across to Tule Lake, which he named Rhett Lake, and then over to Klamath Lake, where he had a run-in with the Indians and lost several of his men. And he was overtaken there by Lieutenant Gillespie of the U. S. Marines, and the party came on back and camped at the Sutter Buttes.

Shortly after that, the war broke out (Bear Flag Revolt), and his group was very active in taking California away from the Mexicans. That put a stop to exploration then. He got into a row with General Kearny and was placed under arrest and was taken east up over the Sierra.

Then, in '48, he organized a group to survey—a private group, this time. He was out of the Army, resigned from the Army after his court martial back at Washington. And he decided to run a railroad through, and he had a curious idea that if he could go through with a pack outfit in the wintertime, they could put a railroad through. Now, what connection there is to that, I don't know. But that was his idea, anyway.

So his fourth expedition West was in '48, and he crossed through southern Colorado, barely got over the Rockies and had to turn back. He went down to Taos, New Mexico and sent back food for the remaining party, and a great many of them starved to death there. And there was cannibalism, and it wound up as a very, very sad thing. Fremont wrote very little about that trip. About all we have on that is a letter he wrote to his wife, which told quite a bit about it, but not all the gruesome details, which he didn't know at that time. But it has been written up since.

Then, he organized another expedition, about '53, another private expedition, financed by the people who wanted a central railroad, or one coming out of the South, preferably, because there was a lot of political pressure at that time. The southerners wanted the railroad to the South and the northerners to the North. And being that our road was built shortly following the Civil War, why, of course, the first railroad took the northern route.

So Fremont came through southern Colorado at that time (1853), through Grand Junction, and west across southern Utah, and came out—I can't recall the name of the place now—oh, yes, Parawan. It's near little Salt Lake. I believe he lost one man on this trip that died of starvation or injuries, I forget which. They were all in pretty bad shape. And they came to this little town, that was by that time settled by Mormons, where they got supplies. And one of his men—can't recall his name now; he was supposed to be the artist of the trip, a Jewish man, and he wrote a book about this. He got his feet frozen, so they left him at this little town and arranged to have him taken up to Salt Lake City, where he spent the winter and recovered and wrote this book. And he has no complaints at all about Fremont. So, it shows that Fremont's men had a very high regard for him, despite the fact [that] he got them into some very tough spots. But Fremont was a man that took the worst along with his men.

We have very little more on that route, although from letters he wrote and things that Mrs. Fremont said, and so forth, we think he

came practically due west, about the route that possibly the Jayhawkers took later, and to the White Mountains, then followed down around the end of the White Mountains and into California. Fremont didn't leave much written about that route. We get it from this man, his photographer, who didn't get any pictures, or they didn't turn out very well. That was the first of the old tintypes, and so forth.

Now, that about covers Fremont's routes. Now, he published his memoirs. It was to be two volumes, and the first volume didn't sell very well, so there was no second volume. Well, the first volume was called number one; there were supposed to be two volumes. And in that, he repeats practically verbatim his Report and also the map that he made in '44 and published in '45, and another map he published in '48 that constituted what he had learned on his '45 trip. He had a very poor map made, didn't compare with these others that were government maps. And he even had Lake Abert misspelled as "Lake Albert."

A funny thing about his getting take Tahoe too far west is that the early maps of California show two lakes. They show Mountain Lake that Fremont had found, and they show Lake Tahoe, which they called at that time Lake Bigler, after the governor of California (not after the Mormon, Bigler, who led the Mormons in the fall of '48 eastward to Salt Lake City and were the first white people through Carson Pass. Carson didn't go through 'til about '53 with a band of sheep. It's named after Carson, which is perfectly all right, because Carson was a great scout. And Fremont named the Carson River after him, and then, Carson Valley took its name from the river, and then Carson City from it being near the Carson River, and Carson Pass, etc., because the river headed up near that pass where people thought Carson had led Fremont through the pass).

Oh, I was thinking about Fremont. He named Pyramid Lake and the pyramid. He named the Truckee River, Salmon Trout River (the name didn't stick). He named the Carson River, which still retains the name, the Walker River, Walker Lake, Owens River, named after Owens (without an apostrophe. That's *Owens*. The man's name was Owens, not Owen. Some people write it with an apostrophe, which is wrong). Those names all stuck. Also, Rock Creek over here, near above Coloma, on the south fork of the American. He named the Coast Range mountains in California, which name also stuck. He named Walker River, Walker Lake, and Walker Pass after Joe Walker, the first man to go through it. He also named the Golden Gate. The name's still retained. So quite a few of his names stuck.

Now, then. You asked how I became interested in Fremont and emigrant trails, and so forth. You know, I didn't have any particular interest or knowledge, knew practically nothing of that sort of thing, except what my parents told me. They knew a lot of the early goings-on in California, but I didn't pay much attention to that. When I got up into Oregon, I became interested (when I went to Oregon State College). The Oregonians were very history-conscious because they were the first Americans to really settle on American territory on the West Coast. Quite a number of people went into Oregon, starting along about, oh, in the late '30's and continuing on to before the Gold Rush to California. There were quite a few thousand Americans in Oregon and had their own government. And they had quite a few retired Hudson Bay trappers there, too. So you'll find quite a few old Hudson Bay names still up in Oregon—Gravais, I went to college with a man by that name, also an Ermatinger, and probably descendents from the old trappers. They have the historic Astoria. One of my classmates

who played in the band—hmm, hardly think of his name; guess I should. He played clarinet beautifully. He came from Astoria; his name was one of the old Hudson Bay names. There are places in the Willamette Valley [which] still carry Hudson Bay names, like Pudding Creek, and I forget some of the others.

Then, when I went over to Reno, where I started teaching at the University of Nevada, finally. I went over there and took a course at the University. And during that time (in 1919-1920), as I have told you, I came across Fremont' s report. It was up in Professor Jones's office. And Professor Jones was interested in this early exploration. And then, shortly after that, along in the late '20's, a little book was published by Fletcher on early exploration in Nevada. Now, those two things started me off, got me interested.

So I started reading, then, a great many things about early exploration through Nevada. I also got a copy of the —many copies of—the Donner Party report, written by [C. F.] McGlashan. They had a great many unsold copies around Reno and Virginia City. You could get them for fifty cents apiece. And I don't know how many I bought and sent to friends of mine, the history of the Donner Party.

Then, when I lived over on Nixon Avenue, I had the basement fixed up where I was writing up my thesis on the geology of the Comstock Lode. And I used to do a lot of studying and reading down there in the basement so as not to disturb people upstairs who'd gone to bed. I used to never go to bed before about midnight. I read a great deal about Fremont and Jedediah Smith and tried to follow these routes as laid out by Fletcher and other people. Jedediah Smith's route was gotten from a diary of a man who was with Jedediah. That covered a part of his route. And along in the mid '30's, I had maps and put down Fremont's route as near as I could put it down, and I was satisfied that Fremont came into Nevada about a mile or so east of the junction point of Nevada, Oregon, and California on Twelve Mile Creek. And I mapped his route roughly as near as I could figure it out from his report. And then I decided that Jedediah Smith, on his first trip west, came down Virgin River. And, you know—by the way, they have a town in Utah, on a tributary of Virgin River that's called La Virkin. And I think that's a corruption of the Spanish pronunciation of the Virgin, *la virgen*. So, "la virgen" and "la virkin" sound very much alike. And I have an idea that's where La Virkin got its name. It's a very odd name.

So I decided he came down Virgin River, and on down the Colorado River to about Cottonwood Island. Because he said he only went down the Colorado for four days, and they all say that there must have been a mistake in his calculation because that wouldn't take him down to Needles, as everybody presumes he did go. But he said he crossed—I think there was an island in the river, and they crossed a broad place. There were a lot of Indians there. That wouldn't necessarily be at the Needles, but at Cottonwood Valley. It was a sizable valley on the Colorado River. He crossed there in '26 and he came back in the fall of '27 and crossed it again. And the Indians attacked him this time. He said when he went down in the fall of '27, he saw but one Indian on his way down through southern Utah, and he said he stayed close to the rock like a mountain goat. In other words, he was shy. Smith was a little suspicious that something had gone wrong, but he didn't think much of it. And then, when he got down to cross over, the Indians told him that there'd been a fight between some American trappers,

and they'd had a row among themselves, and some had gone one way and some the other. Now, evidently, these Indians had attacked the trappers, and that was their talk to make Smith feel at home.

So they helped raft Smith and four or five of his men across, and some of his provisions, across the river, and then they attacked and killed the remaining men on the east bank of the river. Smith and his men went out into the woods and built a sort of a fortification and stayed in that for a night and part of a day. And then they made a break for California. They'd been over this route once before. In fact, it was probably the same trail followed by, oh, Padre [Francisco] Garces in 1776, because he was led over the route to the Colorado River by Mojave Indians. And Mojave Indians showed Jedediah Smith how to get up there on his first trip. And the Mojave Indians traveled that route a great deal and were a pest to the settlers over around San Gabriel. So I think Garces and Smith followed the same route. So, actually, the route that Smith took through Utah and on to California was largely that of Escalante and then Garces in California, and probably a little—fifty miles or so in between the two— that Jedediah Smith had first traveled. But he said he went southwest from there. So if he'd been at Needles, he'd never get to the route he actually came in on, if he'd gone to the southwest. He wouldn't've gone to the Mojave River at all. So I'm quite sure that he followed the old Mojave Indian trail, and probably from Cottonwood Island, now under water.

So I wrote to Mr. Fletcher, who was living at Berkeley at that time, and told him that I had decided, from studying the maps—now, I'd never been up in northern Washoe County at that time, nor had I been down on the Virgin River. I didn't get down to the Virgin River 'til l956; I went into Utah and down past St. George, and then on east across the Colorado River. (Of course, I'd been on the Colorado River in '28.) But I'd never been on the Virgin River 'til a few years ago. So, I sat down in my room, and from what I knew of the topography from studying maps, and what Jedediah Smith had said (or, I mean, his man with him, who wrote this diary), that he couldn't've come around through Caliente as an authority in California had written him up. It didn't fit the topography. It didn't fit the country. There's no stream coming down into Caliente. And that wash coming down, the Meadow Valley Wash that comes down, it comes down from Caliente, is practically a dry wash most of the year. That couldn't've been the one that Smith came down and named Adams River. So from his description, it had to be the Virgin. It was almost an impassable canyon. So I wrote and told Fletcher these things, and he said, "I don't know about Fremont." He said, "You may be perfectly right about Fremont. I know you're right about Jedediah Smith." He also wrote that, "Apparently, you have not seen Maurice Sullivan's book on Jedediah Smith," which had come out just a few months before I wrote to Mr. Fletcher.

It seems strange to me that people couldn't've straightened this all out before. If I can sit in my room and have never been in either one of these areas, and could get Fremont's route correct in northern Nevada and Jedediah Smith's route in Utah and southeastern Nevada, his first trip down the Virgin River, I don't see why other people couldn't, too.

Now, when they found Jedediah Smith's diary along in the early '30's in some building back in Missouri, and in that, he definitely states that he went down what we now call

the Virgin River, described it so there can't be any mistake. I don't see why there could have been any mistake in the first place.

Then the next time he came down, he didn't want to go down that rugged canyon that people wonder how he ever got through it with horses. So he took a road from about Santa Clara and went up the route the highway now travels to the Santa Clara River. And, of course, you can recognize that because he tells about the Indians living there and raising squash, pumpkins, corn, and a few other things. See, the Indians down in southern Nevada had the same sort of food that they raised as the Indians did in New Mexico and Arizona and on down into Mexico. So, the Aztec way of living percolated way up into these places where corn would readily grow, and pumpkins, and squash, and that sort of thing. You know very well it was Santa Clara. And he came through Santa Clara Valley. Then he followed a natural route, once they got into it, and came down practically where Mesquite is, old Mesquite, at the mouth of the Virgin River canyon. The present highway leaves a part of that route on Virgin River where Fremont lost one of his men down there in the summer of '44. The Indians killed a man [by the] name of Tebeau and threw his body into the river. That was one of the few men that Fremont lost on his trip. Another one who got killed by pulling a rifle toward him, a loaded rifle, and as people do nowadays when the hammer catches on something, it discharges the gun. He lost one man that way.

And then, when you read Maurice Sullivan's book that gives Jedediah Smith's route, of course, you can't—well, there's no other out. He came down the Virgin River, just like I thought he had.

Then there's been a lot of discussion, as I told you, about Chase Spring, Whitten Spring, as Fremont called it. And a good many people thought it was Flowery, and some thought it was where Bidwell had given up his wagon, and so forth, and packed oxen. But that was at the spring at Johnson ranch.

So, now, it's quite evident that Bidwell left his wagons and made pack animals out of his oxen at Johnson Spring, Johnson ranch, just below the little town of Oasis, on the northern route through Nevada, 1-80. He evidently didn't see either Flowery Springs or Mound Spring. But he caught up with his group somewhere south of Warm Springs and in Ruby Valley. And we know that, although I've seen maps showing Bidwell going out through Wells. He didn't go that way at all. Nobody went through Wells 'til years after that. They went down the Ruby Valley, and in those days, mountain sheep were so tame that people could kill them right along the front of the mountains. They weren't wild like they are nowadays and stay up on the peaks. And the emigrants even killed mountain sheep along the Rubies. And they didn't go very far up in the mountains, the emigrants didn't, because they were afraid of the Indians, and, you know, they'd be waylaid. And he went around the south end of the Rubies, because he mentions some boiling springs down there that are coated with opal and described in such a way that they have to be springs that are down toward the southern end of the range.

Now, Fremont used the pass going through the center part of the range. I don't recall the name of it now. Fremont went through that, but not many of the emigrants used that until later. They went around the south end and went through what was once called Hastings Pass, and I think it's now called Emigrant Pass. And the central pass, Fremont went through that and got onto the south fork of the Humboldt and followed it up—Huntington Creek, and went through what is now known as Railroad Pass at the

north end of the Diamond range and over into the valley right north of Eureka, and down through that valley opposite Eureka and up through the gap west of Eureka, that he called Swallow Canyon, or something like that, because of the swallow nests on the cliffs, like they are today. Then he went down past Darrough's Hot Springs in Big Smoky Valley. He gives the latitude of those springs and describes them quite well. He camped at the south end of the—what's the name of that mountain range, now, south of Austin? Toiyabe. South end of the Toiyabe range and then across, and joined his party, as I mentioned before, over at Walker Lake. None of the names he gave through there have stuck. He named one creek, Crane Creek, for his Indian guide, and so forth. He named the Humboldt range. And that name has stuck. And he named the Humboldt River, which is also still used today.

So I located Whitten Spring, which is now called Chase Spring (called by the emigrants Mound Spring because there's a mound there, and it trembles when you go up on it). I've never seen the place. But by looking at maps and Fremont's map—now, Fremont showed that he camped at the summit of the first range coming westward from where Wendover now is. Then, he traveled about fourteen miles and crossed another range. Now, that second range would be the Pequop Mountains, the little, low ridge running from Spruce Mountain to the Pequops east of Wells, Nevada. And the Flowery lies east of that little, low, connecting link. The Western Pacific goes through a tunnel there at a place called Jasper. You can still follow the old emigrant trail, or parts of it, coming across from Flowery Spring and over to Mound Spring. So Fremont shows crossing two ranges to get to Mound Spring from Wendover. So the first one'd be the Toana range, and the next one'd be the Pequops. And then, from Mound Spring, I told you where he went from there. The other party mentions going over to Warm Springs and through Secret Canyon (they didn't give it a name), and on down the Humboldt.

An interesting thing about some of the emigrants coming through that pass—when they came over the northern northwestern spur of Spruce Mountain, as the trail went, and they saw Snow Water Lake to the north, one of them said, "There's another one of those mirages on a dry lake." This time it was a real lake, but they'd seen so many mirages [laughing] they thought this was one also.

Now, in reading some of these emigrant diaries, some interesting things were brought out that we don't think about nowadays. And, of course, people nowadays don't drive oxen and they don't drive big teams of horses, not out in this country. And they're frankly, a thing of the past. When I was a boy, there were both ox teams in the mountains, and also a great deal of the freight was hauled by freight teams that passed right by our house on the road running from Marysville up to LaPorte, teams of eight, ten, twelve horses and two wagons. They'd leave Marysville way early in the morning, around three o'clock, and they usually camped at the place, Phillips Corner, just north of our ranch, about thirteen miles out of Marysville. And then, the next day, they would make so far as, probably, at Bangor and probably another eight or ten miles because they'd get at the steep hills at that time.

So there's some interesting things [that] happened. For instance, when Walker went back from California on his first route, we think he went up around Mina. He probably saw Pilot Peak in Mineral County, and thought it was a mountain he'd seen on his way out. And they headed for it. Unfortunately, it was out in the desert. And they had a lot of cattle with them, and horses, and quite a few dogs.

And quite a few of these died of thirst. And finally, he got up somewhere around about where I would judge Rawhide now is, or possible about opposite Brucite, or Gabbs. The horses wanted to bear off to the west, and the people couldn't head them off. They tried to drive them on to the north, and the horses wouldn't do it, and they stampeded off to the west. So the men followed them. And they wound up on the bend in Walker River, about where Schurz now is, because the horses evidently could smell the water. What there is about water that they can smell, I don't know. But it's just like the rabbits finding those buried springs, and so forth. (And coyotes'll do that, you know. There's a lot of places around here in the desert areas called Coyote Wells or Coyote Holes. When you find a place called Coyote Wells, if you'll go out there, you'll usually find holes, oh, from eighteen inches down to thirty inches deep where coyotes have dug straight down. How they get the dirt out, I don't know. They dig straight down to water. They'll dig down as much as two or two and a half feet. So, there's quite a few places over in the desert. There's two places I know of in Nevada called Coyote Holes, or Coyote Wells. There's some out on the Mojave Desert. And that's where the coyotes dug down to water, because they could sense that water underground, much more than we can do.)

And then, some emigrants coming down the route from down the Humboldt River and coming across to the Truckee River, if you come down—that's [Highway] 80 now. If you come down where 80 comes now, just out of Fernley, on certain days, you can see the trees along the Carson River because the mirage brings them up so you can see them. Normally, you can't. I've read of emigrants telling about their horses seeing these trees and wanted to pull over to the Carson River instead of going to the Truckee. Because they evidently sighted those trees and thought it meant water. I didn't know animals, like horses and cattle, would recognize things so far away. Although, I remember when I was on the ranch, we had a couple of big mules that weighed about 1,500 pounds apiece, which is *extremely* large for mules, and fairly large for horses. And they were quite gentle. And we used to use these big mules to haul the wagon out in the field [when] we used to repair fences. And I remember one day, I saw those mules looking way off in the distance, and I looked way off there to see what they were looking at. And I didn't look far enough. Of f about a mile away, there were some birds hopping around. That, evidently, was what those mules had seen. That was the only thing moving that I could see, way off, a mile away. And I wouldn't've seen it, only that the mules were looking out there. So they have pretty keen eyesight.

Then, another case, when Bruff wrote his diary, Joseph Goldsborough Bruff, he led a party of New Yorkers in the fall of '49 and wrote a very fine diary by which you can follow his route very nicely, of course, on the emigrant trail. He drew a lot of pictures, too. And he said that on the way from Rabbit Hole to the hot springs at Black Rock— now, don't confuse Black Rock with Black Rock Point. People are forever writing up meaning Black Rock and calling it Black Rock Point. Black Rock Point is a survey station about four miles east of Black Rock, southeast. And that's the peak that the Nevada Highway Department has established as a triangulation point, they call it. Black Rock Point— and that's not Black Rock. Black Rock's on the west side of the hills. Black Rock Point is east at about twenty some-odd miles from Rabbit Hole over to Black Rock. Now, that was the first water they had. That's a long journey. You

take with a pack outfit, it's not so far. But with teams pulling wagons and through that heavy going—what I mean by heavy, they would mire down in the soft lake beds, and it was a long pull, and it was in August or September and frightfully hot. And a lot of them gave out, and Bruff told about giving water to a woman and her child waiting for her husband to come back with water because her horse had given out. And Bruff told about the oxen seeing a mirage off toward Gerlach, and they thought it was water, just like people do. And they stampeded out toward it. And he said there were a lot of dead oxen lying out on that plain. This is the light-colored clay of an old lake bed. Reading these things brings out just a great, great many things of considerable interest, little things like that, for instance.

Another thing, when I got out to Black Rock, after reading Bruff. Bruff said when he got to Black Rock (this was along in September, late September), he climbed up on top of it, and there was a shower, awfully cold. And he rushed down off of it to get back down again. And I thought he'd welcome a shower. Like, I was caught in one up on Mahogany Peak in northern Nevada, in August, too, a bitterly hot day. And we were dressed for hot weather. And we got up on Mahogany Peak to do some geological work. And there came up a thunderstorm and a hailstorm. And, oh, I thought we would freeze to death! We couldn't get a fire started, and I stripped down and put on heavy underwear and heavy clothes, and I was still cold 'til we pulled down off of there, [laughing] and then we changed back into our summer clothes. Boy, I didn't imagine you could get so chilled in the summer!

So Bruff went up on this Black Rock Peak, and he said up on there, there were crows' and ravens' nests, a rookery. And that struck me as quite odd. I've been out at Black Rock and I wondered why there would be any crows or ravens out there. I didn't see any. The only birds I ever saw there were usually some hawks passing by, or some high-flying ducks or geese or buzzards, large hawks, and such as that—nothing living around there. And then I realized why crows and ravens camped up in that peak. Because with all the emigrants passing over that route, from '46, and especially in '49, when so many people went over it, there was a lot of dead cattle and horses out there. And, of course, that would attract these birds. They lived on carrion. There's none up there now. There were when Bruff was there. So it finally dawned on me. You know, sometimes, you read between the lines and learn a lot of things.

I don't know whether I told you about Fremont crossing north of Elephant Back. I went up on Elephant Back. And the day I went up there, it was so hazy I couldn't see the valley. And I wrote a paper about Fremont crossing through there rather than through Carson Pass, and explained why. And quite obviously, you read, look at his map, you're going due west, he didn't curve up around through Hope Valley to get into Carson Pass. He wasn't wasting time traveling another three or four extra miles when the few miles they had to go, the better they liked it in that deep snow and men on the verge of starvation. And, you know, just one heavy snowstorm, and they'd still be there. They just never would have made it—a normal winter, they wouldn't've made it.

So, when Fremont and Carson went up on that peak along about, oh, we'll say possibly the seventh or eighth of February (maybe earlier, maybe the sixth), they looked of f and saw the Sacramento Valley. And they could see a line of trees; they thought it was the Sacramento River. Well, it may have been the Feather River, who knows? I think probably it was. And they saw some mountains in the

distance. And Carson said, "There's the little mountain. I can recognize it just as plainly as if I'd seen it yesterday," although it was fourteen or fifteen years earlier that he'd been through that country. And in the far distance, they could see the Coast Ranges. And Fremont imagined he could see two streams coming together into a large body of water that he judged was San Francisco Bay. Well, of course, you can't see San Francisco Bay from there.

So, when Carson said "the little mountain," I put in parentheses "Mount Diablo." Well, it wasn't Mount Diablo at all. I put that down because other people said it was Mount Diablo. I should have known better, and I'll tell you why. Imagine what Carson had said: "There is the little mountain." Now, nobody would call Mount Diablo "the little mountain." I should have realized it was the Sutter Buttes. They're a little mountain range, of course. And that's what they saw.

Now, at a later time, I went up on Elephant Back, and I took a bearing with a compass as far around to the left as I could see because of Carson Spur, and to the right as far as I could see because of the mountains there. The valley was full of haze, so I couldn't see the valley. When I got on home, I plotted that on a map and found that they could see off down just about across where Woodland now is, and up about to where Chico now is, and the Sutter Buttes were right in the center between those two lines about one hundred miles away, and the Coast Range is way out beyond them, probably a hundred and fifty miles in the line of sight. I doubt if he could see the Sacramento River. He could see Feather River, of course, but the Sacramento is behind the Buttes. He might've seen it. But you couldn't see any body of water. Now, they were up there, and maybe the Sacramento Valley was flooded. Then there would be ponds of water. I've seen them from up on the hills here. During flood time, you can see the Yolo Basin full of water and the Sutter Basin full of water. They may have seen the Sutter Basin full of water. They couldn't see the Yolo Basin. They couldn't see San Francisco Bay because it was behind the Coast Ranges. They couldn't see Suisun Bay because it was behind Carson Spur. Now, in order to see those things, they would have to climb Round Top. And I'm sure they didn't, or otherwise, they would've said so. At Round Top, you could see Mount Diablo (of course, in those days, they didn't have any smog), and you could get a great sweep of country from there. A good many people said from Carson Pass, Fremont could see Mount Diablo [laughing]. You couldn't see Sutter Buttes; you couldn't see anything. You can't see anything from Carson Pass, except some mountains out ahead of you eight or ten miles away, and the timber cuts off your view. So people should have known, when they wrote up about his coming through there, that he couldn't've come down the ridge by Carson Spur. Because from there, you can neither see the Sacramento Valley, nor can you see Lake Tahoe, and he saw both. You couldn't see either one because they're in timber. And also, the ridge running down from Red Lake Peak is too high to look over and see Lake Tahoe from, where the road from Jackson, California, up to Carson Pass [goes now].

A good many people don't realize that that's not the road the emigrants traveled. The emigrants came straight down the ridge from—well, they crossed Carson Pass, and they went down to the Twin Lakes where the reservoir is now (those are just shallow lakes). They went up toward Round Top. There's a gap just north of Round Top. The emigrants climbed up on there. There's a pass higher than Carson Pass. They had to go that way. You can't get around Carson Spur; it's too

rough and rugged. So if you had wagons, you *had* to go up that way. And then they came down past Silver Lake, where Plasses' resort is now, and then up past Tragedy Springs, where the group of Mormons in '48, were trying to outline the road, and three were killed there at Tragedy Springs by Indians, then down to Leak Spring on that ridge, stayed right on that ridge and came down past Sly Park (which was probably named after one of their men whose name was Sly), and on into Placerville, which at that time was called Dry Diggings until they hung somebody there by the Raffles Hotel. Then they called it Hangtown, a name they're quite proud of now. But forty, fifty years ago, they didn't like the name of [Hangtown]. Now they're glad to have the name back. Just like somebody over in Nevada wanted to change Lathrop Wells to Kennedy. And I told them they were out of their minds. There's thousands of places called Kennedy in the United States, even before Senator Kennedy was assassinated. There's a place up in Nevada called Kennedy, and Kennedy mine, over here in the Mother Lode. There's a lot of other places. And I said, "You've got a unique name. Lathrop Wells. There's no name like that in the United States, I imagine, probably the only one in the world." Like the Great Boiling Springs at Gerlach. I told you about that before.

There's a lot of byproducts from studying these routes and what the emigrants said, et cetera, a lot of byproducts. They told of leaving, oh, tons and tons and tons of ox chains and old wagons. And we heard about people burning up the wagons. And I used to think, "Well, why did they do that?" A lot of people thought that the emigrants burnt up the wagons so nobody else could use them. Well, maybe some did. But you read other people, and they used these wagons for firewood. There's practically no firewood on the Humboldt, except sagebrush, and it makes very poor fuel, as you know— burns rapidly and it smokes everything up. It's a feast and famine in that it burns like oil and then you have to stand there and keep feeding it in. It doesn't last at all. So they used the wagon wood for fuel. Now, what became of the ox chains, I wondered about that. When they built the Lucene cutoff, I think it was, there was a man that went down to Pilot Peak and gathered up all the emigrants' wagon tires and so forth and hauled them into the railroad, and they shipped them off for junk. And every farm, say, forty-five, fifty years ago, before the welding torches came in—every farm had a blacksmith shop, any large farm. They shod their own horses, and they repaired all their own farm equipment and all sorts of machinery. A lot of that was done in the blacksmith shop. I helped to do quite a little of it myself.

I remember our old ranch at Honcut, on the Honcut Creek, in Yuba County. We had a stack of iron scrap out behind the blacksmith shop. I imagine there was a ton there. And [if] we wanted a piece of special iron, we'd go out there and hunt, search that over. We bought very little new iron because it was very expensive, and the farmers weren't flush in those days. They didn't drive Cadillacs and have these big D-8's or -10's, or whatever they use now, to plow up the ground with. So I can remember many, many times seeing a piece of iron along the road, a bolt, or any kind of a piece of iron that was usable, we'd throw it into the wagon or tie it onto the saddle and bring it in and throw it into the scrap pile. And up at our Nord ranch on the Sacramento River up above Chico, when we moved up there, we had a big blacksmith shop. It still has a big pile of iron out behind it. The last time I was up there, there was a big junk heap, you might call it.

Well, that's what became of the iron. It was gathered up along these roads, and what wasn't shipped away for junk was used by the farmers. And even a remote place, like up Black Rock Canyon, where Fremont went around that little short canyon between where the round corral is and Stevens Spring (that's about three miles; the canyon proper is about two miles long), we walked down through there. There is a trail of sorts through there. But Bruff told about throwing aside abandoned wagons so they could get through, and they chopped down trees to get through. And here, they were the tail end of the emigration. But they had to throw things out of the way to get through. And they had to chop down some trees yet, to get through, quaking asp. The only thing we found through there—and I thought sure, we'd find some old relics of some sort. Well, we didn't find a thing except a little round cap that was evidently a cap off the gas tank or radiator, or something like that. So it was quite modern. We found no junk at all.

Now, another thing, when the Fortieth Parallel Survey that came through and surveyed a strip about a hundred miles wide along the Central Pacific Railroad from Omaha, Nebraska west to the Nevada-California boundary west of Verdi, they came by a place on the Humboldt River where they were smelting—milling and smelting ore from some of the nearby mines. (Gosh, I can't think of that place! It's out beyond Lovelock and before you get to Humboldt, before you get to the Rye Patch reservoir.) Anyway, there, they used to use bone ash to filter sugar, purifying sugar. I think now, they probably use diatomite. But there was a lot of bone shipped to the Hawaiian Islands and burned to filter the sugar. So you can always think when you get cane sugar, it's been filtered through the bones of dead cattle or horses, and so forth, but pretty well cremated. So we used to use bone ash in assaying to make what we called cupels. When you run an assay, you get the gold and silver down into a lead button that weighs about twenty or thirty grams. You put that into a bone ash cupel, which is about, oh, an inch and a quarter in diameter and probably three-quarters of an inch high and it has a depression in it. Then you drop the button into that and it melts, and the lead goes of f as oxide fumes. And the gold and silver remains behind, the platinum, and some other things, a bead they call [a] doré bead. Well, anyway, there s a lot of that bone ash. Now, they burned these skeletons up and used them to make a bone ash cupel, only it's a hearth (we call it a hearth), about four feet square, four or five feet square, and probably six inches thick. It took a lot of bone ash to make that. And then, they'd put their antimony and lead, silver, on that and attempted to refine it. They'd drive the lead off as an oxide (which they would condense in a sack and save), and the silver separated out behind, and I think they separated off the antimony similarly.

Then the Fortieth Parallel Survey remarked that at that time when they came through—now, this was in the '70's. This was after the railroad was completed. It was probably the early '70's, I presume; I'm not so sure. Anyway, it was in the '70's. And at that time, which, you see, was twenty years after the big emigrant rush, the road was just lined with skeletons of animals that died on the way, and some humans with them, no doubt. Bruff mentioned numerous graves along the road, people that died of cholera, starvation, and other things, scurvy, a lot of scurvy. And the Fortieth Parallel said there was enough bones there to last this smelter a hundred years. Well, the smelter didn't last a hundred years, probably was there fifteen or twenty

years, gone long before I went to Nevada. So there were no bones—no skeletons—along that road when I first traveled it. Oh, there might be an occasional one here and there, but nothing like they said. They were all gone. Now, where'd they go? Well, people gathered up the bones and shipped them out by train, and they were used, I suppose, in some places to make glycerine. And after that was extracted, they were made into bone ash and shipped over to the Hawaiian Island to refine sugar. And there was a lot of sand shipped from Marysville to the Hawaiian Islands to refine sugar, too, and they're still shipping sand out of Marysville out of the Yuba River. That old sand plant is still running out there. And they've shipped thousands and tens of thousands of tons of that sand away. But those are some of the things, sidelights, that come in from reading these reports. And you can read between the lines quite a lot of things.

Another thing, when Fremont got down to Sutter's Fort, he took a lot of readings on the eclipses of the moons of Jupiter. That was one way they had of getting time to determine the longitude. You get the local time from the eclipse of the moons of Jupiter and you would compare that with your time (you would carry it with a chronometer), and it was supposed to be Greenwich time.

Well, anyway, Fremont got down to Sacramento, and he tells about a lot of time he spent getting the correct time. Well, now, I kind of question whether he could get the correct time. Well, what he could do, there had been many, many navigators who had been at Sacramento, like some of the British navigators, two or three different ones, and a French navigator had been there. And others, Americans, had been up to Sacramento before that time. So I think the longitude and latitude of Sacramento was well known. And then, starting from that, he could compare the time that he was trying to get, set his chronometer to going again. And knowing what the true time should have been, he could know how much fast or slow his chronometer was. Because from that time on, going east in 1844, his longitudes were relatively accurate. So I have an idea he got a time settled not from his reading of the stars but from knowing the longitude from previous determinations. When he came out in '45, he was too far west, in longitude, when he came across Nevada, by about six or eight miles. And down here at the Sutter Buttes, he was off about—I think it was eight miles too far west, also. I plotted it out on a map once where I knew he was and where he gave the longitude and latitude. And he was too far west by, I forget, something like eight miles, which is not bad, carrying a chronometer all the way from St. Louis out to here, carrying it on horseback. And there's very few people [who] could do that. Most of them, they couldn't bring chronometers out here and have them continue to run, like the man who surveyed—captain Stasbury. One of the islands in Salt Lake's named after him, too, or a mountain range out there. lie came out in '49 and surveyed Great Salt Lake in great detail, and Utah Lake and the Jordan River. But he took Fremont's longitude because his own chronometers were proven inaccurate.

You ought to read a novel by [George H.] Stewart. He's at the University of California. He wrote a novel. I didn't know before that he wrote novels. I found out he did. He wrote one called *Sheep Rock*.They just called it *Sheep Rock*. And it describes the country at Black Rock. He tells about the cabin burning up as though he burned it himself. He talks like he's a graduate student living up there, and he stuffed his thesis into the stove. He got disgusted with it and set fire to it. And then he drove of f, and he looked back and saw the cabin burning up. Well, I know when the

cabin was there, and I know about the time it burned up. Now, whether he was out there, I don't know. He might've been. And he tells about seeing a mountain sheep out there that went of f into the distance. But I rather question a mountain sheep coming down there because the mountains are so low and there's so little vegetation on them that I doubt if mountain sheep'd come down into those mountains out in the desert, not nowadays. They used to in the old days. But it made a very interesting novel. And I remember seeing that building out there. Maybe I was out to it; I don't know. I could see a light burning there at that building many a time when I was up through that country, and I was over to the building once or twice.I've been back there many times since it burned up.Anyway, that's a very nice novel.

And another thing about that building burning up. They had a haystack there. And the haystack was made out of that grass growing around the springs. That water is rather strong in various salts. The emigrants thought it was very good drinking water because they hadn't had any for a long time, but it's not very good water. And the grass that grows around there, I think they call it salt grass. It contains a lot of silica. And when this house burned, also, the haystack they had there burned. And the haystack had so much silica in it that it left a lot of glass from the contained salts that melted together. I have some out here in the garage now that I got up there, well-formed glass from the burning of that haystack.

And that's not uncommon with ordinary hay, even. And the burning up of roots of trees sometimes, or coal underground burning will melt the rocks and make glass or slag. And when they had the big fire in the Argonaut mine, I understand some of the rocks there melted into glass, or slag. Lewis and Clark mention the slag from burning coal up in the Dakotas. Somebody told me those coal mines are still on fire. I don't know whether they are or not, probably set on fire by lightning, or maybe accidentally by the Indians.

This work of Bruff's was put out in a two-volume edition along about [19]45, and a one-volume edition in '48 for the centennial of the Gold Rush, and it was called *Gold Rush*. Two women wrote it; I've forgotten their names now. They were from New York, and they were descendants of Bruff. And whenever Bruff mentioned anybody, if they could run down this person, they always gave a little synopsis about this person's career, and so forth. For instance, when Bruff came down the Humboldt, he met a man going up the Humboldt with some supplies for some establishment the United States government had out there. And he was taking supplies up there, and he was a lieutenant so-and-so. [Laughing] So they wrote up his career, and they mentioned that he was cashiered out of the army because of irregularities in his account keeping. I suppose he got rid of some of the money that belonged to the government. So he was cashiered. So you get a lot of interesting things like that, but as I said, reading between the lines—. Just like the thing I told you about Mount Diablo and Sutter Buttes. If I'd've really figured out what he had said—well, I've gone over this before, no use going over it again.

Oh, yes, I might tell you something about Bruff's trip. Now, Bruff, he got bogged down up in the mountains up here about twenty-seven miles up from Vina. And it was a very snowy year with lots of heavy precipitation, deep snow in the mountains. And he was snowed in. And he stayed there to protect things that he and his party had. And the other emigrants, they promised to come back. They never came back to him. And

some young fellow came along and decided to stay with Bruff, and he did. He went out and did the hunting and killed deer, so Bruff had something to eat. He stayed with Bruff quite a while, and he was anxious to shoot a grizzly bear. And Bruff thought he better not, because, unless he killed it outright, he may have difficulties. Grizzlies are very savage. But he finally disappeared and never showed up any more.

Now, not far from where Bruff stayed, there was a creek called Skeleton Creek. And I kind of wonder if that was the remains of this man who wanted to shoot a grizzly. He probably shot his grizzly, all right, and the grizzly got him.

And then after a week or two had passed, another young man came through late on the emigrant trail. And he stayed with Bruff. And then, toward spring, this young man went out to get help and went down to Sacramento, and the rivers were all flooded and he had a very difficult time getting down to Sacramento and getting back. By the time he got back, Bruff had decided to walk out. And he met Bruff just within a couple of miles of the first settlement in the valley. Bruff mentions it.

Now, the Mill Creek Indians that the farmers up there used to have battles with, and the sheriff would get a posse and they took along plenty of fire water and slaughtered Indians whenever they ran across them, guilty or otherwise. Any Indian was fair game with them. And that was in the neighborhood, you know, where Ishi was found. Now, Ishi was up on Mill Creek, and he had been discovered, or his family had been discovered by some surveyors in 1908. And at that time, about that same time, my brother and I were on a trip up into the mountains to Mt. Lassen, and when we came home, we camped in Soldier Meadows. Now, Soldier Meadows is on Butt Creek, and Butt Creek is on the old emigrant trail. Of course, we didn't know it at that time. But while we were there was when these surveyors were over on Mill Creek and came across Ishi's family and run them out. And they stole all of—well, tore up everything they had in their little camp. They didn't have much. But they took the bows and arrows and anything else they wanted off with them. Then it was three years after that, 1911, when Ishi showed up at the slaughterhouse down at Oroville. Of course, we were interested in that because my folks knew the sheriff, and we knew this man, Grubbs, who lived up in the hills around Bangor, and we knew most of those people up there. And Grubbs was out at the slaughterhouse. And up in Oroville two or three years ago, I met a man who had been there at the time when Ishi was found. And due to my finding this man (he had been chief of police in Oroville at one time), we got him to recite the discovery of Ishi at the slaughterhouse. And they brought in a tape recorder and recorded all that, and it was published in the publication down here at the historical society at Pacific University of Stockton. And you can get this man's version as against [the author's] who wrote a book about Ishi. She was a [wife] of a famous anthropologist that wrote up a lot about Indians. I can't recall his name now, very famous man. This Oroville man gives a little different version. He said that the one was wrong in that book on Ishi.

Of course, they said Ishi was the last of the Stone Age men. Well, I wonder. You know, they said the last of them. Well, there's some pretty wild places still left. Well, not so much in the United States, but down in Mexico and South America. Now, when I was down in Mexico in '56 (now, this Ishi affair was way earlier than that, 1911), Mexican geologists told me, when we stopped at Tomasunchale, he said [in] the country off

to the west of there, the Indians were quite wild. And these men, these geologists, some of whom were practically full-blooded Indians themselves, spoke English beautifully. I wish I could speak Spanish like they speak English. Most of them are educated in the United States, a lot of them with the University of Oklahoma. And they said they didn't dare go into that Indian country doing geological work without first acquiring a guide, quite a prominent Indian who was well known to the Indians themselves, to serve as a guide. They wouldn't dare go in there alone. And there's places down southeast of Mexico City that, even now, the Mexican armies don't dare go in there because the Indians'll clean up on them. They just don't want any officials in their country. So there may be some Stone Age men around there, or in the depths of the Amazon jungles, et cetera.

But, be that as it may, there's quite a few things about these emigrant trails that people overlook. First of all, a good many people don't go over the trail. They try to work it up like I did on Fremont and Smith, just in my home. But I had an advantage over quite a few people because these men mentioned some things about the geology and topography, which I understood. And I could see maps and visualize the country, whereas a good many of these writers can't read a topographic map, and they can't read a geological map. And when Fremont said he "now moved from the lava rock onto the granite," the first time since he'd been out of the Blue Mountains in Oregon, of course, I knew it was true. I knew what he was talking about. And so a good many of those things helped me, because I know where they have to be, to be on those sort of rocks—at times, I do (of course, not all the time).

I told you why I spotted where Fremont was, where he had the latitude, which is an east-west line, and the contact between the lava and the granite's practically a north-south line, and I plotted it within a very short distance. And there was other things like that, I could read these maps, like where he crossed two mountain ranges that he shows on his own maps. And I knew one was the Toano range, and I knew the other was the Pequops, a little ridge that connects Spruce Mountain with the main Pequop Mountains. And then about Bidwell, with his boiling hot spring coated with opal inside; he didn't call it opal, he called it something else, but that's what he meant. And I know Fremont went around to the east and south of Spruce Mountain, and I was able to follow his route quite well through there in a jeep. I knew he went through the pass in the center of the Ruby range, instead of around the south end, like the emigrants went. But from his description, though, he had to go that way. And from the description of the Donners and what Bidwell said, you know they went clear around the south end.

And then, you must be careful to not rely too much on what somebody else has written. That's where I got into my error on Mt. Diablo, because somebody else had said Mt. Diablo, and I said, "Oh, yes, it's probably Mt. Diablo." I learned later, of course, you couldn't see Mt. Diablo unless you got up on Round Top, or somewhere in that neighborhood.

Oh, I might say something about Bruff, too. Now, these women that wrote up his diary. They continued the diary, also, to the trip that Bruff and Peter Lassen and a man [by the] name of Jones and I can't remember the others (seven or eight) took a trip up looking for Gold Lake, all the big excitement on Gold Lake in 1850. It was an interesting thing, that when they (Bruff-Lassen party) came down to the Feather River, they heard about the discovery of gold down on the north fork at Rich Bar. But they didn't know just where it

was, and they went down the river, and they didn't get down far enough to find Rich Bar.

They went on up, back on the emigrant trail, and when they got up about to the—south of Big Valley, south of the Thompson ranch on Pit River, where the trail went up over the hill and came down to Grass Valley, near Bugnadas mill, they left the trail and took off to the east. Now, I'd like to follow that trail, and I think I could. These two women thought they could, and they thought he came down Snow Storm Canyon. It's the canyon that comes down where the Southern Pacific Railroad goes up to Ravendale, that canyon. Snow Storm Canyon, I think they call it, something like that. There're petroglyphs in there. And they thought the petroglyphs that Bruff mentioned were in that canyon. Now, if that were so—well, they simply wrote to or asked a forester at Susanville where there was a canyon with rocks like that and Indian petroglyphs. And they said Snow Storm Canyon, which also has petroglyphs. So they put down, "He came down Snow Storm." Now, if you know the country, you know Snow Storm lies way of f, four or five miles to the west of Highway 395. Therefore, if Bruff came south through there, in order to get to the pass where 395 goes through now, where they've got a bronze plaque up saying that Bruff came through, and he didn't. But now, it's in bronze, so he must have.

Now, here's what Bruff said. When he came down this canyon where the petroglyphs were, the creek curved and went off to the east. And Jones and his party went east, and Peter Lassen said he would not go any further east. So Bruff and Lassen and a few others went due south from the bend in this creek. Now, there's no such a thing in Snow Storm. There's no creek there except during very wet weather. The creek Bruff was on was Smoke Creek. And it goes down into the Smoke Creek Desert. And at the bend, they went due south, through a divide, and came down onto a brushy creek (still called Brush Creek). And they started down that creek, and they thought it was too bad a place for an ambush, so they came back up out of it and continued on south. And during this day, they traveled fourteen miles and camped at a spring, which has to be Bull Spring or Mud Spring, or one of those in that vicinity to the north of the high peak. Now, the next morning Bruff said they went to the southeast. But he was wrong. They went to the northwest, because they couldn't've gotten where they got to, going the reverse direction. He had his compass direction turned around. But they passed a rock corral built by the Indians. Now, if I could find that, you could spot it exactly. He made a sketch showing the pack train all lined out. And looking off to his left, he saw Honey Lake. Therefore, the lake is to the west, and if it's to your left, he must've been traveling northwest, and not southeast, as he would if he came down out of Snow Storm Canyon. If he came out of Snow Storm Canyon, he'd never [have] seen Honey Lake at all 'til he came to the pass at 395 where the railroad goes through, and then the lake would be of f to the south of him. But they went through the gap in the hills and down *to* the lake, and followed up the lake a few miles. And they mentioned the hot springs and saw the smoke coming up, and the steam. But he thought it was the Indian fires making smoke. And he mentioned some ridges there. Then he came around the north end of the lake, and they went across the Susan River and camped over at the other edge of Honey Lake. And he drew a sketch showing the mountain back of which they had camped the night before, which wouldn't be Snow Storm Canyon. Now, I figured all of that out.

Oh, yes, they came down upon Honey Lake. They must've been about where that railroad station now is, where the track is branched. One track goes over toward

Westwood and that direction, and the other one goes up to the road going up to Lakeview. Anyway, from his sketch, oh, yes, they had to be traveling—if the lake was to the left, and the lake is west of their trail, then they must be going to the north or northwest. And they camped at the northwest corner of Honey Lake because he drew the north shore of the lake running straight away from him in a straight line. Now, these girls, the ones that wrote that up, they got him camping up at the next town north of there. I can't think of this little town at that corner. And he got a nice picture of the lake. Across from the lake, he's got this peak that he thought there was a crater in the top of it, and that they had camped back of that hill. Now, that's Hot Spring Peak, I think they call it now. And Smoke Creek, he thought, came around and came into the south end of the lake. He thought by looking over that way, you could see a stream coming in at the south end of the lake. Well, of course, Smoke Creek dies out in Smoke Creek Desert. Now, Jones could've told him that, but I guess he probably didn't discuss it with Jones. And there's a creek [that] does come into the lake down there, Skeedaddle Creek. And whether he could see that with binoculars from where he was, or a field glass, I don't know. Maybe he could. But, anyway, the sketch shows where he came down.

Well, now, after this, I ran across a piece in the *Gazette*, where a schoolteacher from up in Siskiyou County had been out there on Smoke Creek. And he found a rock that Bruff pictures in his drawings, with Bruff sitting on his little saddle horse. And he drew this triangular-shaped rock, and on that was a peculiar thing. It looked like a cart like a laundry wagon with bundles on top of it and— which made some people think maybe the Indians had wheeled vehicles. But it's just imaginary doodling, no doubt, because there were no wheels known in North America, or South America, you know, when the whites came here. If they did, the civilization would've probably developed in a much different direction than—well, they had practically no beasts of burden, either, except a few llamas in South America. And they had no wheels.

Then, there was some things that looked like a snake and a few other writings, and this man's photograph, if you compare it with Bruff's drawing, and although Bruff took some artist's license in drawing this rock, it was the same rock. We went up there looking for it one time and couldn't find it. But we walked up the creek about two miles or more (and we went on an awfully hot day) and came back down the old road and back to camp. But Bruff made out like this rock was right on the banks of the creek and he couldn't get out of the creek until they got down to this bend. Well, he exaggerated that. In that two miles we walked, there was a great many places you could ride a horse out of that canyon —to the east in many places, and off to the west (it was about a north-south stream). Off to the west, you'd ride out into quite a few places. And it so happens that this rock was way back from the creek, we learned afterward, and that's the reason we missed it, back among some juniper trees.

Now, since that's been straightened out, I would like to figure out the rest of Bruff' s trip with Lassen. He mentions a peak. I think he called it Hat Peak because it looked like a Mexican hat to him. And he mentioned they split rock with opal covering it. It was at a spring, and across the way, there were some white pinnacles, just like those he had drawn pictures of and mentioned in the Forty-Nine Pass. He shows those pinnacles that are eroded out of that siliceous tuff like that up in Forty-Nine Canyon. There's also some like that over on Pit River. And he mentioned

those. Somebody said it was a mountain of magnesia. It's siliceous tuff. Of course, they didn't know so much about those things in those days. Can't blame them one bit. And to take Bruff's compass readings shows that he mistook Mt. Lassen and Mt. Shasta and probably some other snowy peaks. Because I've taken those bearings with his sailor's way of giving them and plotted them on a map, and put him up near the Oregon line. Well, now, he did not pass the emigrant trail after he left it. So, he couldn't've been up above Pit River as it runs through by Alturas. He saw a peak near Alturas, Rattlesnake Peak. And he saw another peak to the west of the emigrant trail [which] he mistook to be the same one, but it wasn't. So, he and Lassen didn't get anywhere near the emigrant trail. I think the nearest he got to the emigrant trail was Madeline [California], and Madeline Plains, and probably the little lake with tules around it near Madeline. Or they may have gone over the mountains and found the south end of the lakes in Surprise Valley. That's the farthest possible north they could have been. And I think going over that country and probably discussing it with some of the cattlemen, they would recognize this split rock near the spring and these pinnacles he talked about, and some other things.

One thing he did get—. Now, it shows that he mapped his route fairly accurately, because, when he was coming south through Smoke Creek Canyon, he said, "Now we're about fifty miles east of where we left the emigrant trail." And I scaled it off on a map, and it is within four or five miles of what he had. So his route is mapped fairly accurately, and probably you could follow it on the ground. And I would like to do that sometime and write it up.

7

Summary and Conclusion

I don't know. If I was going to do it all over again, I—oh, of course, if I had control over affairs, I'd've handled them quite different from what some of the cases were. But all in all, I think I've had a very interesting and satisfactory life. I have no regrets. I, of course, probably would have done better, or think I would, if I knew as much as I know now. That remains to be seen, however. We don't know what you would have done under certain circumstances until you get there. Frequently people say, "Oh, if that had been me, I'd've done so and so." Well, they might have. And still, again, they might have done nothing. You don't know. You don't know. You can't plan ahead, like, well, something's going to happen; I'm going to do so and so. Well, most times, you do the first thing that comes to your mind, and there may be a great many things that happen then that you can't foresee.

We had a professor, [Douglas Wilson] Johnson, at Columbia University, who was a very, very good authority on erosion phenomena, especially ocean shorelines. He wrote a textbook on that, and he wrote quite a few articles on physiography, or physical geology—physiography, I guess we should say—or the origin of land forms and that sort of thing. He showed us one day in class how he reached a certain conclusion. You lay out a proposition and/or you come upon a problem. And then you think of all the possible solutions of that problem. And then you take up each of these solutions and do your best to prove that it would be the way that things would turn out under those circumstances. And if it fails to, you lay that aside, and you go right on down until you get one that you can't disprove. And then you have the right answer.

I put this to him, and it made him very angry because Professor Johnson didn't want to be crossed up. He always felt he had the final solution to everything. And I said, "But suppose you didn't think of all the possible solutions?" And, of course, you know, now, that is true. Because back forty or fifty years

ago, you couldn't think of all the possible solutions to a certain set of geologic facts. Because as time has gone on, if you go back to that same problem today, with up-to-date training and with all of the geophysical instruments you have for reading down into the earth and aerial photographs that we didn't have then that you could study the earth from, and photographs taken from outer space with infrared filters, and so forth, that show us many, many more things than we can ever see even on earth or flying over it, don't you see? Many, many more facts are given to you on a given problem today that you never even dreamt of back in those days. So my question was a perfectly valid one: but supposing you don't think of all the possible answers?

Even today we can't think of all the possible answers that somebody with more modern training or future training fifty years from now would see in that same problem. So, to say that under certain circumstances you would do such and so—if you felt like you do now, and knowing what you do now, and feeling the way that you do now, you might do as you think—as you now think you would. But when that thing happens, the condition may be utterly different than you anticipated, and your reaction may be very much different than you had thought it would be, and so you'll probably act on the impulse of the moment. And if the thing happened over again eight or ten times, you'd probably do something different each time, because some things you never get prepared for.

So I'm perfectly satisfied with the way that things turned out, and I'm reasonably happy and enjoy life as well as you would expect an old person my age to be enjoying life. All in all, I have been very, very fortunate. I like to get out into the hills, and I love the vegetation and everything out there, not only rocks, but trees, running water, and birds, animals—and just the freedom of the wide open spaces, whether it's out here in these mountains [near Auburn], or whether it's off in the wilds of Nevada. I can enjoy that country also. So that's about all I can say about [laughing) that sort of thing.

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